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THE PARIS EXPOSITION.

The great Universal Exposition which opened last week in Paris shares the common fate of such enterprises in not being ready. Indeed, it may be questioned whether a month later it will be fully swept and garnished and ready for its half-a-million daily visitors. Those who remember Chicago in 1893 would find their memories vividly awakened in Paris at this moment by the countless signs of tardy but feverish preparation to be seen on all sides. It is a little bit difficult to understand such tardiness. Wars come so suddenly, one can understand why an army should discover with surprise that its equipment is not complete, but exhibitions are planned years in advance, the locations are known, the dates are fixed and the programme is prepared with stately elaboration. It may be hoped that the exhibitions of the new century soon to dawn will, with the multifarious aid of electricity, in transportation, transmission of power and means of communication, change this bad habit of dilatoriness and procrastination that has been manifested by all the World's Fairs of the Nineteenth Century.

We are glad to learn from our representatives in Paris that the electrical and mechanical groups are well advanced at this moment, and that American exhibits are in specially good shape. Several American exhibitors in these particular classes have, as is well known, sustained a severe check and loss in the total disappearance of their exhibits at sea. We are ourselves among those who have thus suffered, so that our sympathies with the sufferers are tinged with a peculiarly strong personal feeling. But the damage has been repaired wherever possible, and happily in many instances delay will be the only result of the disaster. It would appear that as a matter of fact exhibits in almost every section were on board the French freighter Pauillac, but it is of course in regard to heavy electrical and mechanical apparatus that the loss has been most keenly felt. It is too bad to think that in an age of so many great triumphs, we are not yet emancipated from the perils of the sea; and that an argosy freighted with beautiful achievements of the mind and hand can vanish from the face of the waters without even sending an etheric message of despair and farewell.

ILLUMINATION AND CANDLE-POWER.

In the entire range of his calling, the electric light man finds no part quite so unsatisfactory as that relating to candle power and illumination. When discussions at meetings of electric light associations touch on these subjects, this condition is almost invariably voiced in remarks on the insufficiency of knowledge of the kind useful to those buying and selling artificial illumination. The lack of such knowledge is particularly felt when questions arise, as they so frequently do, between central stations and municipalities concerning street lighting. Having no source to which to refer for authoritative guidance, disputes that might otherwise be settled amicably, are apt, through the influence of arbitrary dicta of "experts," to lead to ill feeling and sometimes to gross injustice toward the seller of light.

In our issue of last week, the first number of a serial by Dr. Louis Bell appeared which will, without doubt, be welcomed by the electric light fraternity for its promise to ameliorate the unsatisfactory condition above referred to. Since electric light is now the standard artificial illuminant, the treatment of principles will nat-

urally be from the standpoint of electric lighting, and it is needless to say that no one is more competent to write from this point of view than Dr. Bell. As will have been noted, the first sections of the serial take up fundamental principles. Later the subjects of candle power measurement, the arrangement and distributions of light sources to give the most satisfactory illumination, and other matters of direct practical interest in electric lighting, will be considered, in greater or less detail as seems most warranted.

HEAVY ELECTRIC TRACTION.

While in this country the subject of heavy electric railway traction has scarcely yet passed beyond the academic stage of discussion, the Italians appear to have taken up the matter in a business-like manner. Elsewhere in this issue, an Italian contributor gives a long list of roads now being equipped for electric traction, which serves to show once again that besides being pioneers in electrical science, the Italians are second to none in carrying out its practical applications. As will be seen, a system of so-called trunk lines, having an aggregate length of eighty-three miles, is now in process of transformation from steam to electricity. Another company is about to apply electric traction on its mountain lines, aggregating several hundred miles in length, and in still another instance the main lines of a company in two provinces are to be operated by electricity. It will at once be remarked that water power, which is so abundant in Italy, will be used for generating purposes in all the cases noted. Undue stress should not, however, be laid upon this circumstance in reflecting upon the feasibility of similar applications of electric traction in this country. Where electric power is generated in large quantities with modern apparatus and at a fairly uniform rate, the difference of cost, as has been shown by calculations based upon New England mill practice, between steam and water power may even be in favor of the former. The success of heavy electric railway traction in the few instances where it has had a trial in this country has been sufficient to justify its extension at a greater rate than has been attained.

AUTOMATIC CIRCUIT BREAKERS FOR HIGH VOLTAGES.

The use on high-voltage circuits supplied from sources of great power of switches operated by some auxiliary power, allows a most simple and satisfactory solution of the problem of equipping such circuits with automatic circuit breakers. By simply inserting relays designed to respond to the conditions to be protected against, these relays controlling the auxiliary power of the main switches, the latter can be made into automatic circuit breakers. Such a course has been adopted in the case of the New York Metropolitan plant, the automatic relay features of which are described in another column.

The circuit breakers of this plant are operated by means of compressed air in order to give ample force over the desired range of movement of these large devices. The circuit breaker is in many cases such a distance from the operating board that an airpipe connection between the two would give considerable time lag in the operation of the device, a serious objection when synchronizing alternating-current machinery. On this account the control is effected electrically by means of an auxiliary low-voltage circuit between the operating board and the magnet of the circuit breaker, this magnet operating the valve of the pneumatic cylinder. With the added auxiliaries constituting the relays designed to respond to overload or reverse-current conditions, the complication of the apparatus becomes considerable, but it is difficult to see how it can be reduced. A solenoid in place of the air cylinder would, in order to give the necessary pull over the required distance, have to be of extremely large size, wasteful of current and difficult to switch out of circuit. A motor might be used in place of the air cylinder, but its operation would be too slow both when opening and when closing the circuit unless it was arranged in such a way as to tighten a spring in either one or the other direction, this spring to be tripped by some further controlling device, a complication which would probably be as objectionable as the pneumatic arrangement.

The relays, in order to be responsive to the circuit conditions against which the apparatus is to be protected, are preferably made sensitive, and hence are incapable not only of operating the air valves directly, but even of making and breaking on their own contacts the current of the magnet operating the air valve. Hence, in the Metropolitan apparatus they are made to open and close the circuit of a tripping magnet on the controlling switches, which in turn open the circuits of the magnets, they in turn actuating the valves which direct the air pressure, which finally operates the circuit breakers proper. While this may appear to be a somewhat lengthy train of events for dynamoelectric machinery, it is more than equaled in electric switching and signaling devices as well as automatic-motor controlling and train handling apparatus now in commercial use.

SECTIONAL BUSBARS.

In this week's instalment of the article on the polyphase equipment of the Metropolitan Railway in New York city, there is described a rather novel arrangement of the busbars in sectional instead of the usual duplicate plan. As pointed out in the article, the arrangement resembles in principle closely that now commonly adopted in high-pressure steam mains or headers. The dynamo current are led into the busbars at various points throughout their length, the feeders being tapped out at intermediate points, the busbars being divisible by switches so that one section, with its corresponding dynamos and feeders, can be shut down in case of trouble or necessary changes upon it. The resemblance between this arrangement and that commonly used for steam mains suggests the close analogy that exists between the general requirements of busbars and steam headers. As the steam main constitutes a sort of equalizing cross connection, distributing the fluctuations of any one engine between the several feeders and rendering the pressure on all uniform, so the busbars serve electrically as an equalizing cross connection, bringing all circuits to the same pressure and distributing the fluctuations of load of one feeder throughout the whole battery of generators. Just as a break-down of a steam main cuts off the supply of steam to all engines unless the break-down is isolated, so a break-down of the busbars cuts off the supply of current to all feeders unless isolated. To a certain extent, therefore, lessons learned in steam-piping work may be profitably applied to the general features of busbar design.

A sectional system of busbars with feeders from several of the sections to each center of distribution allows greater flexibility for independent running, separate voltages, etc., than does a duplicate system. Even greater flexibility would be obtaind by the adoption of a ring system, which could be made, if necessary, even more flexible, by cross-connecting switches between several points of the ring. Where the units become of such size and pressure that the switches in the generator leads, as well as those in the outgoing feeders, must be made of a specially large and complicated construction in order to break great powers, a sectional busbar system becomes of great value since it involves only half as many of these switches as would be required were all of the generators and feeders connected into two different sets of busbars. This is a notable saving, particularly in instances like that of the Metropolitan station, where two switches are placed in series with each other in each generator lead and in each feeder in order to provide a reserve means

of opening. A sectional system, of course, necessitates switches to divide the sections, but these need not be of the elaborate construction and large size necessary in the branches from the generators to the feeders, since they need never be opened under load, all current into and out from one section of the buses being cut off by the generator and feeder switches before that section is isolated from the others. This, of course, presupposes a short-circuit-proof construction of the busbar, a vital necessity in very large systems.

ELECTROLYTIC RECTIFIERS.

Mr. Hildburgh's article, the conclusion of which appears this week, is an interesting summary of experimental work in a direction that offers much electrochemical interest; although up to the present time no important engineering application has been developed therein. There is apparently no reason why a practical electrolytic rectifier cannot be used, and the electrolytic storage cell, now used so extensively, was not many years ago confined to purely experimental apparatus on the smallest scale.

Mr. Hildburgh divides asymmetrical electrolytic conductors, or current rectifiers, into two-cell rectifiers, and single-cell rectifiers. In the former, an auxiliary cell is used to establish polarization in one direction without furnishing current. In the latter, the auxiliary cell is dispensed with, and the dissymmetry of the single cell is solely relied upon to effect rectification. An alternating e. m. f. of suitably low frequency and strength is impressed upon a circuit containing the cell. Each current impulse or alternation sets up polarization or c. e. m. f., but owing to the dissymmetry of the cell the c. e. m. f. is so much greater to one set of waves, say the positive, that to the other, or negative waves, that the former are denied passage to a greater or less extent, while the latter are not materially interfered with. This results in the production of a current that would under ideally perfect conditions be unidirectional; while under ordinary circumstances, there is an asymmetry in the positive and negative waves, equivalent to a resultant reduced strength of pulsating unidirectional current. The ratio of the resultant quantity in this useful direction, to the total quantity traversing the cell without regard to sign, is defined as the asymmetrical efficiency. This kind of rectifier is to be distinguished from the aluminum-cell apparatus possessing similar characteristics because the action in the latter is generally admitted to be almost entirely due to asymmetrical resistance instead of asymmetrical c. e. m. f. A skin or film of insulated hydrate forms over the aluminum plate, when the latter is the anode, and is dissolved off, when it becomes the cathode.

The difficulty from a practical standpoint with an electrolytic rectifier lies in the low efficiency of the apparatus. With rectifiers of the ordinary rotating commutator type; i. e., converters, the efficiency is well over 90 per cent., and an electrolytic rectifier must do better, before it can find a welcome; unless it should be cheaper to install, which is, to say the least, doubtful. The vagaries of electrolytic mechanisms are at once interesting and perplexing. The ordinary voltaic cell of dissimilar elements furnishes a unidirectional current, and a particular type of such cell, the Clark cell, constructed with special care forms the concrete unit of reference for e. m. f. Another type, the storage cell, initially provided with similar elements, serves to store energy electrolytically for direct-current work. A third type of electrolytic cell—the Wehnelt interrupter—provided with a small cathode, automatically produces a pulsatory unidirectional current from a unidirectional e. m. f., and enables an alternating current to be obtained therefrom by induction; while a fourth possessing dissymmetry of elements, as described in Mr. Hildburgh's article, when inserted into the circuit of an alternating e. m. f., converts the current into an asymmetrical one with resultant unidirectional properties.

The current absorption or condenser action of electrolytic elements, when inserted in alternating-current circuits, has been known for about ten years, and efforts have been made from time to time to employ the electrolytic condenser in such circuits, for the purposes to which electrostatic condensers are ordinarily used. The low efficiency of such cells seems to have stood in the way of their success as condensers. The relatively very large capacity they possess per unit of active electrode surface has long made them attractive to electricians as possible substitutes for dry condensers. In such cases, of course, the electrodes are made as nearly symmetrical as possible, in order to suppress asymmetrical or rectifying tendencies.

RELATIVE VELOCITIES OF POSITIVE AND NEGATIVE IONS UNDER ELECTROSTATIC FLUX IN GASES AT NORMAL PRESSURES.

In a recent paper read before the Royal Society, Prof. Zeleny describes a series of experiments in which the velocities of ions were measured. According to Prof. J. J. Thomson's theory, when Röntgen rays illumine a gas, some of the atoms in the gaseous molecules may perhaps be regarded as being split or partly disorganized by the separation of a chip or a "corpuscle" from such atoms. The chip is the negatively charged ion, and the relatively large remainder of the atom is positively charged. It is to be expected, and various experiments seem to have shown, that the negative ions or chips, being so much the smaller, move faster than the positive ions, or atoms denuded of a chip. In fact, this marked difference between the velocities of positive and negative ions under similar conditions seems to have been one of the principal supports of this "corpuscular" or subatomic theory. It becomes important to determine the relative ionic velocities under all available physical conditions.

In the case here considered, the gas subjected to Röntgen rays was at ordinary temperatures and pressures; so that the mean free path of the molecules would be very small therein. The natural velocities would be masked by the enormous number of collisions occurring in any appreciable interval of time. The experimental conditions were, however, very ingenious. The gas under trial was forced at a slow and uniform velocity through the annular space between a pair of concentric metal cylinders insulated from each other, and maintained at an adjustable steady potential difference. This caused an electrostatic flux, or gradient of potential to be established in the annular region permeated by the flowing gas. A narrow beam of Röntgen rays was brought to act transversely upon the cylinders to ionize the gas. In the electrostatic field the ionic charges would be urged along the lines of electric flux, and the actual motion would be a combination of this electrically produced transverse motion and the steady forward motion of the gas. Each ion would describe a curved trajectory, whose length depends upon the ionic velocity, and after dividing the internal cylinder by an insulating septum placed beyond the Röntgen beam, an electrometer connected with the extra length served to indicate whether the ions struck the inner cylinder beyond the septum. The potential difference between the two concentric cylinders could be adjusted so as to make the ions just reach across the septum, due corrections being made for diffusion.

The general results with four dry gases—air, oxygen, hydrogen and carbonic acid—seem to show an average velocity of negative ions about 25 per cent. greater than that of positive ions, and all were of the order of one centimeter per second when referred to an electrostatic field of one volt per centimeter.

Opening of the Paris Exposition.

On Saturday, April 14, the Paris Exposition was formally opened by President Loubet in the presence of a large gathering of invited guests. According to cable dispatches, the event was a brilliant affair, everything combining to make it successful. All of the public buildings and numberless private houses throughout the city were decorated in honor of the occasion, and the neighborhood of the Exposition was especially gay with bunting, while most of the pavilions themselves were surmounted with floating banners. As to state of completion, the American section showed up as well as that of any other country, and better than most. According to a list of exhibitors, the United States is the second in numbers, standing next to France. The American exhibit occupies 329,052 square feet, with 47 distinct exhibition spaces, 33 in the main exposition grounds, and 14 in the Vincennes annex, excluding the ground covered by the National pavilion in the Quai D'Orsay. The inaugural ceremonies were of the simplest character. In the evening there was a general illumination of the exposition buildings. No motive power will be ready until the end of May, and in a great many of the buildings, the state of unpreparedness was very much in evidence.

Automobile Race.

On Saturday, April 14, an automobile race took place under the auspices of the Automobile Club of America on the Merrick road, between Springfield and Babylon, L. I., for a silver cup presented by Mr. L. Blanchet, one of the founders of the Automobile Club of France. The distance was 25 miles and return, a total of 50 miles. The race was won by the only electric vehicle entered, that of Mr. A. L. Riker. The other contesting vehicles were gasoline and steam carriages. There were fifteen entries for the race but only nine vehicles started. The machines were started at intervals of thirty seconds, Mr. Riker drawing the right to start first. His vehicle was a low-built machine capable of making quick turns and carrying a battery of sixty cells. When he finished the race he said he had enough power left to take him to New York.

The road over which the race took place was, in the main, very favorable for such a contest and with the exception of about ten miles over a rough and sandy stretch, Mr. Riker ran his vehicle at its highest speed. Mr. Riker's machine was the heaviest of all the racers, weighing 2500 pounds, and it has surpassed all previous records in America for a high-speed run. At the twenty-five mile turn, Mr. S. T. Davis was in the lead with his steam vehicle, but a heavy head wind on the homeward run cut down the speed of the lighter vehicles, enabling Mr. Riker to beat his nearest rival by 15 minutes and 30 seconds. Mr. Davis, however, had to stop twice and refill the boiler of his machine with water, thus losing considerable time in doing so. Mr. Riker covered the distance of fifty miles in two hours, three minutes and thirty seconds. He started at 10:24 a. m. and finished at 12:27:30 p. m. The other contestants were S. T. Davis, Jr., who rode a steam automobile; Alexander Fischer, in a gasoline motor; D. Wolf Bishop, Jr., driving a Winton gasoline motor; A. C. Bostwick and G. F. Chamberlin, each in a Winton gasoline carriage; C. J. Field, in a de Dion French automobile, and David H. Morris and William H. Hall, in steam vehicles.

New Jersey and Pennsylvania Independent Telephone Conference.

About sixty of the largest independent telephone companies of Pennsylvania and New Jersey were represented at a conference held in Harrisburg on April 10, for the purpose of organizing an independent telephone association to secure independent long-distance service. The conference was held behind closed doors, but those at the head of the movement gave out enough of what transpired at the meeting to indicate that the independent companies of Pennsylvania and New Jersey are so strongly in harmony as to be practically one corporation except in actual operation. It is stated that an understanding was reached as to all important matters and the chief object of the conference—the obtaining of a long-distance service—will be accomplished without delay. There was a full and free interchange of opinion as to tolls and division of same between the companies under a combination for long-distance service. There are almost 100 independent telephone companies in Pennsylvania. Mr. A. M. Woerstall, of Philadelphia, read a report showing that the independent companies represent 40,000 telephones in Pennsylvania and New Jersey, and two-thirds of these companies were represented at the conference. Mr. George W. Beers, of New York city, representing the Telegraph, Telephone and Cable Company of America, made an address describing the best telephone methods and making some suggestions as to protection.

Among the subjects discussed were the following: "Report of Interstate Traffic Committee," S. E. Wayland, Wilkesbarre; "Objects and Benefits of State Organization," James H. Thomas, Philadelphia; "Local Organization and Construction," Edward Davis, Philadelphia; "Long-Distance Telephone," George W. Beers, New York; "Legislation," Ward R. Bliss, Chester; "Our Enemies," Fred DeLand, Pittsburg; "The Telephone Versus Plate Matter," B. F. Meyers, Harrisburg; "Taxation," John P. Helfenstein, Shamokin.

An organization was completed by the election of Senator C. W. Kline, of Hazleton, as president. The other officers elected are: Edward W. Davis, of Philadelphia, vice-president; H. B. M. McNulty, of Chambersburg, recording secretary; S. H. Browne, of Pittsburg, financial secretary; and W. R. Bliss, of Chester, treasurer.

A Pacific Cable Bill Passes the Senate.

The Senate, on April 11, passed the bill appropriating $3,000,000 for the construction and laying of a cable between San Francisco and Honolulu, the work to be done under the supervision of the Navy Department, which has made the survey, and determined the practicability of the routes. In this work the bill provides that the Navy Department may use any of its ships that can be adapted to the task of laying the cable, and if it needs other ships that it may charter them wherever they may be found. In addition to this it is provided that the Secretary of the Navy, in his discretion, if he finds it is not practicable to lay the cable by the force of his own department, may contract, under specifications and due advertisement, for the construction, laying and equipment of the cable provided for. Section 5 provides that the cable, wires and other instruments, materials, appliances and appurtenances necessary in the work of laying said cable shall be of American manufacture, provided that the same be procured at a cost not exceeding 12 per cent. above the price the same can be procured in foreign markets. Mr. Hale, chairman of the Committee on Naval Affairs, said that the estimate of three millions was merely for the cable to Honolulu; that afterward the question of further extension could be decided, and that the route might be from Seattle or San Francisco, north by the Alaskan Islands and Japan.

Street Railway Consolidation in Chicago.

The directors of the Chicago Union Traction Company on April 14 authorized the officers of the company to close the deal for the consolidation of that company with the Chicago Consolidated Traction Company. This is the culmination of a series of negotiations between the Yerkes system of suburban surface lines and the Chicago Union Traction Company, by which the latter secures control of 207 miles of electric railway on the North and West Sides of Chicago.

The proposition submitted to a vote of the Consolidated Traction shareholders was one under which the stockholders were asked in December to deposit their stock with the Illinois Trust and Savings Bank in accordance with the agreement by which the stock was to be transferred to the Chicago Union Traction Company in exchange for 4½ per cent. bonds on the basis of a valuation of $45 a share for Consolidated Traction stock. It is understood that the bonds will be in the nature of a collateral trust issue, the interest on which will be guaranteed by the Union Traction Company. The time for the deposit of stock expired on December 31, and it is said that about $13,000,000 of the $15,000,000 was turned in by shareholders. The deal will give the Chicago Union Traction Company complete control of surface lines on the north and west sides of the city.

Preparations for the Paris Exposition.

NO one who visited the Paris Exposition at the present moment (April 7) would imagine that it is intended to open the doors to the public in another week. Even those who have been watching the swift progress made lately can hardly believe it possible to clear up the débris from the paths and roadways, much less get the buildings and exhibits in shape. It is said that a big body of soldiers will be thrown on the grounds to clear up at the last minute, but there is work enough in sight of that character for the whole French army. There is a rumor that the doors will duly open on Holy Saturday—a rather strange choice of date—and then close again for a few weeks, but it would be foolish thus to miss the gate money of the curious sightseers of whom Paris is now full. Besides, expositions have a knack of hasty toilettes, and of a sudden

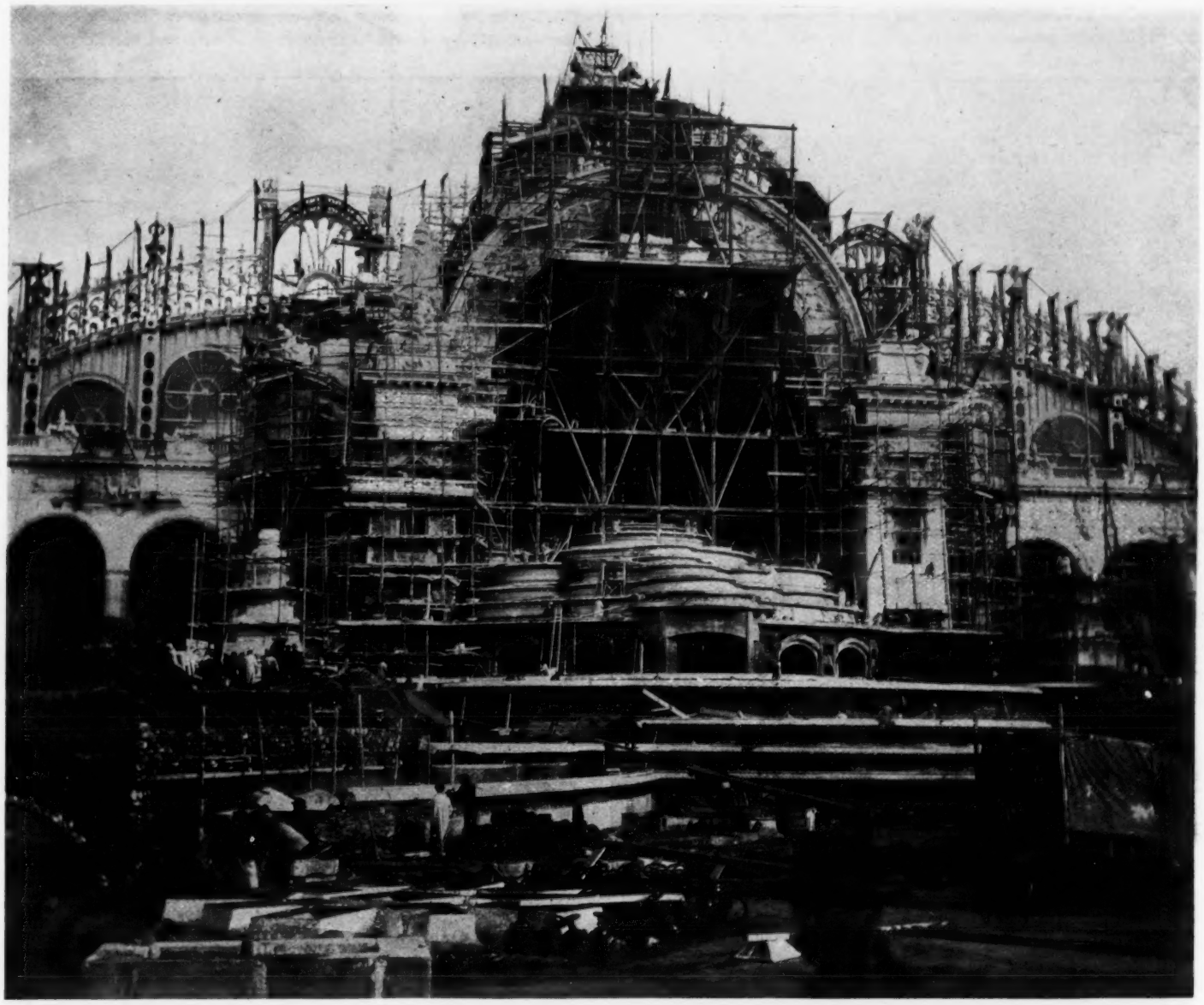


Fig. 1.—Chateau d'Eau, Electricity Building, One Week Before Opening of the Exposition, Showing Steps for Descent of Water.

get themselves up bewitchingly even while the visitors' knock echoes at the door. Compared with Chicago in 1893, Paris is well advanced, for the hammer, pipe cutter, steam roller and engineer were busy in Jackson Park well into the summer. It is noteworthy that France herself is the most behindhand, while at Chicago it was remarked that she was one of the very first to be ready. The present tardiness may be due to the courtesy of the authorities in bending all their energies to help out foreign exhibitors. Be that as it may, large areas in the French sections of electricity and machinery are still as bare as barn floors.

America has really the right of line so far as active preparations go, and in electrical and mechanical work would be far along but for the loss of the Pauillac, to which reference has already been made in these columns. But Yankees are not easily downed or daunted, and even now duplicate exhibits are on their way, less likely to suffer delay in ocean transit than at congested Havre, whither Commissioner General Peck sends a force every now and then to dig out official exhibits of importance, with the aid of the United States Consul. Of course it is impossible, for example, for the John A. Roebling's Sons Co. to replace their exquisite 30-foot model of the Brooklyn Bridge, but their Trenton factory still has a few spare lengths of cable and insulated wire. As for the American power plant, designed for the Bois de Vincennes supplementary exhibit, as soon as the loss of the Pauillac was tolerably well confirmed, Mr. F. E. Drake, director of machinery and electricity, set to work to get a temporary plant, and, the French Westinghouse Company coming to his disposal, soon had ready a plant comprising Willans engine and Crompton generator, which will be running in about ten days. Meantime a duplicate Bullock generator is en route to be hitched up to the Ball engine. Fortunately there is no lighting required at Vincennes, the power plant being necessary for day service only.

The overflow of the machinery exhibit of the United States to Vincennes was unavoidable, but is a nuisance. It is no joke to have to travel six miles in Paris, and at the instant the quickest route is by way of the Seine, on which a round trip by one of the "monches" or "hirondelles" takes two and a half hours, with a decent walk thrown in. Unhappily there are no electric launches as at Chicago, and if one tries a land route, the difficulties are serious, because Paris is all torn up in the very effort to add to its transportation facilities. Practically all the bridges across the Seine in the area enclosed by the exhibition are barred to the public, and the arterial Pont de l'Alma which remains open and to which all traffic therefore tends is having a conduit system laid upon it. This bridge is

also closed to the public at certain hours, so that the delays and blockades can be readily imagined. If one wishes therefore to communicate swiftly between, say, the United States Commission on the Champ de Mars with distant Vincennes, the telephone remains. It is to be wished that the subscriber who kicks and complains about service in New York could spend an expiatory week in Paris or London, trying to get central every five minutes. Possessing one's soul in patience is an art now being developed to its finest quality in Paris. There are the slow street cars, and there are lots of gasolene automobiles flying around, gaudily painted, like disjointed sections of a Barnum circus parade, but none of these availeth for a run of six miles. Of electric cabs, moreover, there are said to be only some twenty in Paris, although there is a report that the vehicles lately used by the Electric Cab Company of London are to be brought over for use on the Paris streets during the exposition, having been bought at the knockdown price of $800 apiece, which makes them too cheap to be good. It might be said incidentally that the slow telephony is not altogether the fault of the personnel or the apparatus, but of conditions pertinent to other ages than that of which that invention is one of the triumphs; while the use of the service is quite unprecedented.

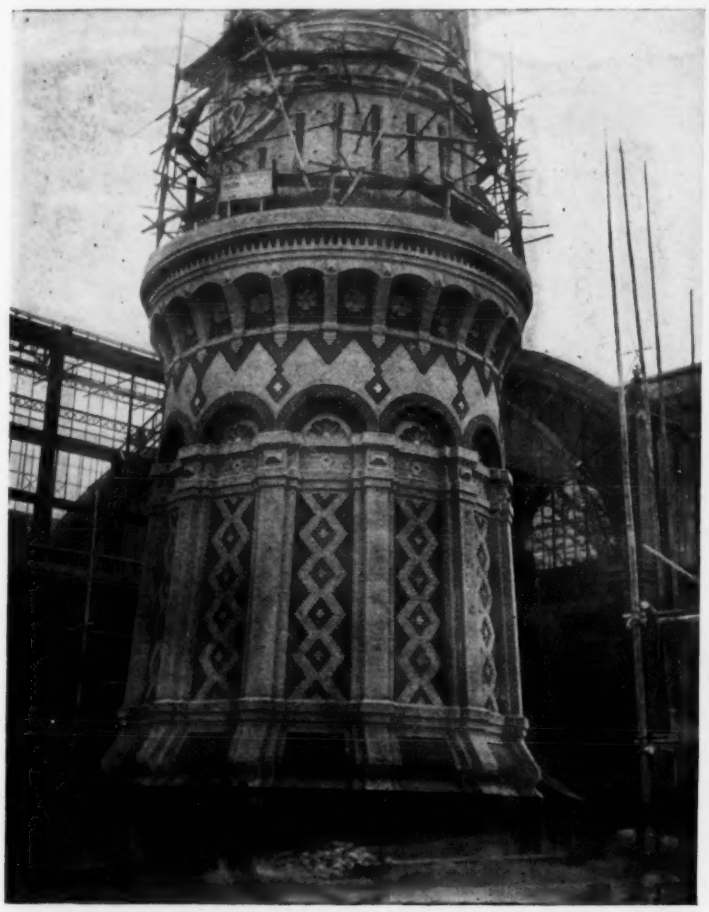


FIG. 2.—BASE OF CHIMNEY, FOREIGN DEPARTMENT.

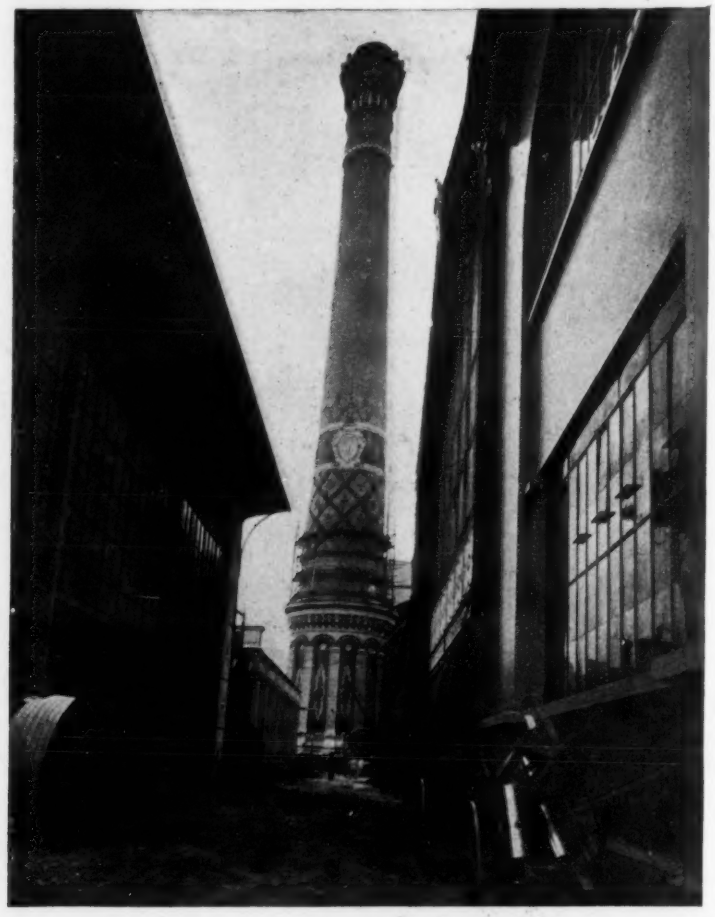


FIG. 3.—CHIMNEY, FRENCH BOILER SECTION.

As though ordinary delays were not sufficient, the exposition has suffered greatly from bad weather, and April found its thoroughfares a mass of mud and wet plaster, with every track covered by cars, inside and outside the buildings. The mechanical, electrical transportation and engineering sections have about 500 cars in them waiting to unload, with others converging from all points of the compass. Just when they will all get unloaded and shunted so that aisle floors may be laid over the rails, no one knows. At the same time, trenches are being cut in every direction for the lighting and power conductors, the cables being spiral armored and laid in the bare earth. In the American section, Mr. Drake has run his own wires and cables in iron pipe, with much better results. He has so far used about 45,000 feet of wire, all furnished generously by Washburn & Moen (American Steel & Wire Company). The United States Government Building, on the Street of Nations along the left bank of the Seine, will have illuminations all over its façade and its huge dome on which the national eagle has swooped. Inside on fixtures there will be approximately about 1700 incandescent lights. All the wire is in conduit, and the wire is double gutta percha insulation, not a foot of weatherproof being used by the United States anywhere. The number of exterior lamps is calculated at 1200. The fixtures inside were made by Oxley & Enos, of New York, with special design and finish. The lamps used are of the Packard "window," or round bulb type, furnished by the New York & Ohio Company, of Warren. O. Current is supplied at 2000 volts three-phase, 50 periods, by the French authorities, and stepped by static transformer down to 110 volts. It is passed in through a fine marble switchboard made specially by the Crouse-Hinds Electric Company, of Syracuse, N. Y. The regulations allow only 3 amperes on an ordinary tap or 5 amperes for a bunch light, and a plain porcelain box cut out is supplied with usual fuse wire. In the Divers Arts Section, the American façade will carry about 3000 lights, fed through a Crouse-Hinds board, and in the Mining Section the American exhibit takes about 500. The American electrical space on the ground floor of Electricity Building will be specially lit by Mr. Drake with some 50 Western Electric enclosed arcs, two in series on 220 volts, and two on a post, designed specially. In the gallery, some 20 Toerring enclosed arcs will be placed for the smaller electrical exhibits there and the Salon d'Honneur. Mr. J. S. Anthony, the Assistant Director of Machinery and Electricity, is also putting some 500 lamps of 10-cp General Electric make, 220 volts direct, two in series, on the American Court, which is his special care. The lamps will be enclosed in holophane globes designed to throw a pure white light down on the relics, models, etc. At the reception given to the Commissioner General on April 3 at the Palace Hotel, Prof. Woodward, the Assistant Commissioner, created much satisfaction by stating that upon the occasion of the opening President Loubet would pass through the American Court of Honor. This brings with it, however, the task of being ready by that time, a responsibility of no mean order.

Within the space of the Lorain Steel Company, on the ground floor, a switchboard is being set up by the United States Department chiefly to take care of motors up to 25-hp for various exhibits, with 220 volts direct current, three-wire, i. e., 440 on the outsides. The Lorain exhibit of motors, by the way, was lost on the Pauillac, but will be replaced, and is interesting as the only one specifically of American street railway apparatus. Just across the aisle, the Gen-

eral Electric Company will have a superb model of all its American factories, many feet in circumference, with swinging easels of large photos to show its plants. It was virtually impossible to bring over for mere exhibit purposes one of the large four or five thousand horse-power generators, and President Vreeland, of the New York Metropolitan Street Railway Company, when sounded about it by the authorities, said it would cost him at least $200,000 before he would get through, if he spared one. In the adjoining space of the Western Electric Company—which also has a space immediately above in the gallery, of Aboilard & Co., its French house—has a most comprehensive exhibit, including an exchange in full operation and connecting up with the outside world.

The Electricity Building proper lies directly in the rear of the great Chateau d'Eau, which faces toward the Eiffel Tower and the Trocadero, the latter looking down from its lofty platform on the right bank of the Seine. The Chateau will be a beautiful edifice when finished, brilliant in shining glass by day and radiant in the electric fountains and electric lights by night. It is decidedly one of the "clous" of the exposition, but at this moment is still in the earlier stages of construction. Its head is a mass of white hairpins of scaffolding and the cascade terraces at its feet are grimly suggestive of the excavations of Pompeii. Here will circulate the water of the

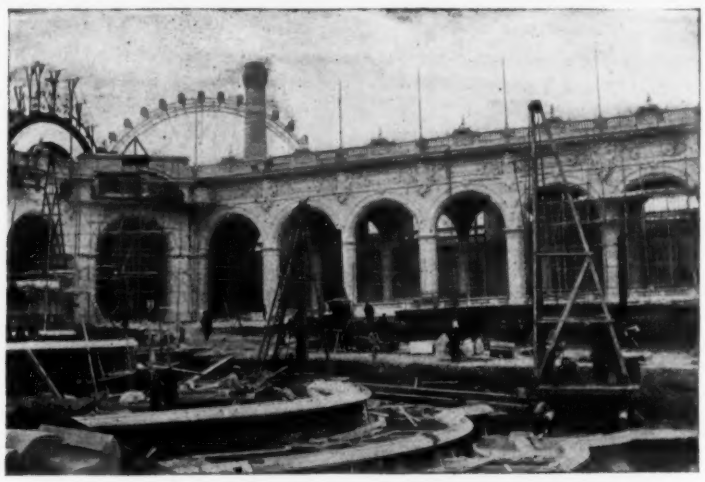


FIG. 4.— GALERIE, CHATEAU D'EAU, SHOWING CHIMNEY, FOREIGN SECTION, AND FERRIS WHEEL.

boiler plant to the extent of some 20,000 or 30,000-hp possibly, though that seems an exaggerated figure. Over the left shoulder of the Chateau and behind one of its wings rise the smokestack of the foreign section of the power plant and the duplicate Ferris wheel. Far behind lies the old Machinery Building (Galeries des Machines), now a bewildering mass of architectural types and enclosing another complete building, Festival Hall (Salle des Fêtes). All throughout this section the use of electric light will be profuse.

Within the grounds, the arrangements for transit promise to be good. The moving sidewalk, with its Westinghouse equipment, has already been tested, and the third rail road, which either parallels or passes under it all the way, never parting company, is also in fair readiness to start up on opening day. Within the buildings there are numerous traveling stairways well forward in construction. These reach the galleries, and as there are in reality no greater heights for the multitude to ascend, the general absence of elevators, electric or otherwise, may be condoned. For the feeble and infirm abundant rolling chairs, as at Chicago, are promised, and it is a rumor that some of these will be electric. Self-propelling many will undoubtedly be.

Proposed Municipal Telephone System in San Francisco.

A call for proposals for a municipal telephone system, to be acquired by the city of San Francisco, has been drawn up by request of the Public Utilities Committee of the Board of Public Works. Included in the specifications are: A central and substations, wires to all parts of the city, conduits and poles, switchboards and all other apparatus necessary for a complete telephone system. The capacity must be sufficient for 25,000 subscribers with provision for its increase to 50,000 when required. All proposals are to be submitted by July 31 next.

The Polyphase Distributing System of the Metropolitan Street Railway Company of New York City—IV.

By J. E. WOODBRIDGE.

THE CONTROLLING CIRCUITS AND RELAYS OF THE OIL CIRCUIT BREAKERS.

OWING to the omission of several of the diagrams of connections in the last issue of the ELECTRICAL WORLD AND ENGINEER, part of the description there given is reprinted below with the proper illustrations included.

The local 125-volt direct-current circuits of the magnets of these oil circuit breakers are closed through controlling switches which may be operated by hand, but are in many cases fitted with magnetically operated triggers designed to make them and the oil circuit breakers open automatically. These triggers are controlled by magnets and release the switch blades when their magnets are affected, making the controlling switches into automatic circuit breakers serving as relays to transmit a circuit change from their magnets to the magnets of the valves of the oil circuit breakers. There are two types of these automatic controlling switches, one designed to operate the oil circuit breaker in case of an overload upon the line, and the other designed to operate for either overload or reversal of the direction of power transmission. In the former type, the connections of which are shown in Fig. 14, the coils of the automatic controlling switch are connected with series or current transformers in two legs of the line to be protected, so that in case an overload comes upon this line the magnets in the automatic controlling switch are energized, pulling up their armatures, giving a hammer blow to the trigger,

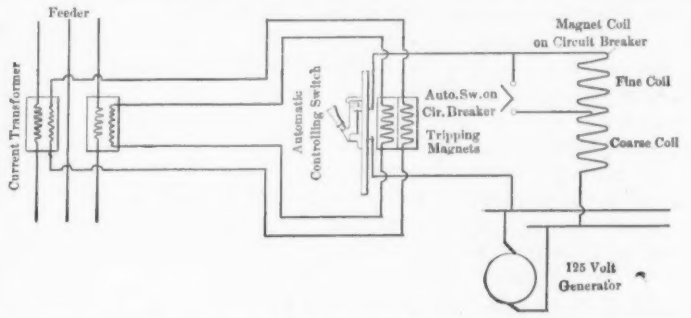


FIG. 14.—CONNECTIONS OF OVERLOAD AUTOMATIC CONTROLLING SWITCH.

releasing the blade of the automatic controlling switch, and opening the circuit. The other type of automatic controlling switch has a direct-current magnet, no alternating currents being admitted to the switch at all. The circuits of this direct-current magnet are opened or closed in relays actuated by the alternating currents. The trigger is released in this controlling switch when the magnet is de-energized. In order to prevent arcing or burning of the contacts of the relays that first close and open the circuit of the magnet of the controlling switch (these contacts being somewhat delicate) this magnet is wound differentially with two coils, one of which is normally closed to hold the armature up, the other—wound in the reverse direction—being thrown in parallel with it to demagnetize and release the plunger and allow the switch to escape from the trigger.

The circuits of this device are shown in Figs. 15 and 16, one showing the connections to an overload relay and the other to a reverse-current relay. It will be seen that the differential tripping coil of the controlling switch is connected in series with the circuit from the controlling switch to the magnet of the oil circuit breaker. A contact is so arranged that while the switch is being closed the differential tripping coil is short circuited by the switch blade so that the full difference of potential of the source of supply is on the coarse coil of the magnet on the oil circuit breaker, setting up a large current in this coil and giving quick action to the valve. As soon as the blade of the controlling switch reaches the closed position the short circuit around the differential magnet is removed, and as soon as the valve is operated a fine coil is connected in series with the coarse coil in the magnet of the circuit breaker valve. The overload relay consists simply of two alternating-current solenoids connected respectively in the secondary circuits of two series transformers in two legs of the line to be protected against overload. In case an overload current passes through either of these transformers the solenoid of the corresponding relay

draws up its plunger, closing a contact which throws in the differential winding of the magnet of the controlling switch, which in turn releases the trigger of the controlling switch, the latter opening and cutting current off from the magnet operating the valve of the oil circuit breaker, which in turn is forced up by compressed air, breaking the main 6000-volt circuit.

The reverse-current relay, as its name implies, is intended to operate in case the power in the feeder to be protected tends to

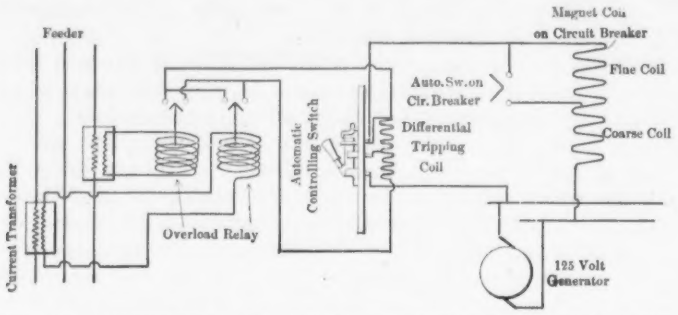


FIG. 15.—CONNECTIONS OF AUTOMATIC CONTROLLING SWITCH WITH DIFFERENTIAL MAGNET FOR OVERLOAD PROTECTION.

flow in a direction the reverse of normal. Its location and purpose will be described later in relation to the circuits. With alternating currents it is, of course, impossible to determine the direction of flow of power from the direction of flow of the current alone, as is possible with direct current, since the current is constantly reversing, no matter which way the power is flowing. The only way to determine whether the transmission of power is in one direction or the other in an alternating circuit is to obtain some reaction between the current and the electromotive force. This is obtained, as shown in the diagram, Fig. 16, by using a small motor as a relay. The motor resembles closely an ordinary direct-current General Electric fan motor with laminated fields. Current from a series transformer is circulated in the field winding of this motor-type relay, and current from a potential transformer is passed through the armature and commutator via the ordinary brushes, the armature circuit being preferably supplied from Y-connected transformers (although not so shown in this drawing) so that the currents in both the armature and the field of this motor relay are in phase with each other when the load is non-inductive. Obviously the reaction of the armature and field gives a torque to the relay in one direction. If the flow of power reverses in the main circuit to which the series and potential transformers of the reverse-current relay are connected, the direction of the mechanical torque exerted in the relay reverses. The armature is not allowed to rotate, but carries a crank which rests normally against a dead back stop, but which turns into contact with a live front stop when the mechanical reaction reverses. This live front stop is connected, as shown in the diagram, to the differential magnet of the controlling switch, operating the latter and thereby opening the oil circuit

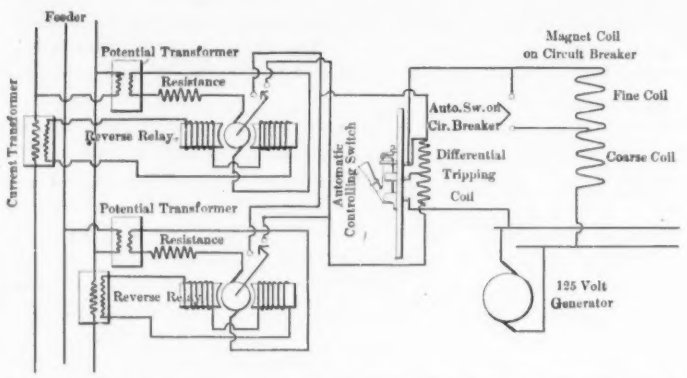


FIG. 16.—CONNECTIONS OF AUTOMATIC CONTROLLING SWITCH WITH DIFFERENTIAL MAGNET FOR REVERSE CURRENT PROTECTION.

breaker automatically. Two relays are necessary in each line connected in two different phases so as to protect against a reversal in any one of the three phases.

There is incorporated in the structure of those controlling switches, which have automatic releasing triggers, an ingenious detail to indicate whether the switch has been released by the automatic devices or pulled open by hand. The handle has two positions with reference to the switch blade, in either of which positions it is held by a notch when once set there. On pulling the switch open by hand, the inclined edge of the trigger resists the motion of the blade, compelling the handle to slip to the lower notch before it will pull the blade away from the trigger. On closing the switch the handle slips to the upper notch before it will push the blade in. If a switch is open with the handle in the upper notch it indicates that the switch has been released by the magnet and trigger, and has not been pulled open by hand. On looking down the line of switches any one that has opened automatically will be seen instantly as its handle will stick out at a different angle from the others.

This arrangement is clearly shown in the two illustrations on one of these controlling switches given in Fig. 17. The left-hand illustration shows the switch closed with the handle forced up to the upper notch, and therefore making an acute angle with the arm carrying the wing contacts. The right-hand view shows the switch open with the handle forced down to the lower notch, making an obtuse angle with the switch arm. If the switch is open with its handle in the upper notch, making an acute angle with the switch arm, it is evident that the switch has been released by the automatic trigger, and that it has not therefore been pulled open by hand.

THE GENERAL SCHEME OF THE HIGH-TENSION CIRCUITS.

All of the eleven 3500-kw generators will be connected to one set of three-phase busbars, there being no duplicate or spare busbars provided. On this account the occurrence of a short circuit across the

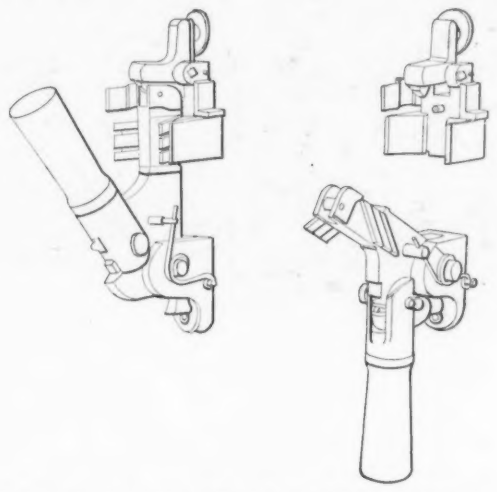


FIG. 17.—PERSPECTIVE OF ONE OF THE AUTOMATIC SWITCHES IN TWO POSITIONS.

high-tension system would cause a tremendous and probably disastrous concentration of power as well as interrupt a very important public service. A feeder or a generator can be cut off by its oil circuit breaker in case a short occurs upon it, but the busbars themselves cannot of course be cut off without generally disconnecting the generators from the feeders. On this account a highly novel construction, described below, has been provided to remove any possibility of short circuit at this vital part of the system.

The one set of busbars is arranged on a novel sectional and divisible plan so that power can be kept on the system continuously, and yet any part of the buses can be cut off for alterations or repairs. The current from all of the generators is not brought into one section of the buses and carried as a whole to another section from which the feeders tap it off, as is usual in low-tension practice. On the contrary, the busbars are divided into four sections by knife switches, the jaws of which may be bolted into good contact. Some of the generators and some of the feeders are connected to each section, so that in case it becomes necessary to repair or change any section of the busbars the generators and feeders connected to that part can be shut down and disconnected by means of their oil circuit breakers, the section can be isolated from the others by opening the bolted knife switches and repairs or changes can be made on that section dead, service being continued via the other sections. Different sections of the buses can be run for different classes of service if desired or at different voltages, greater divisibility being gained in this respect than with duplicate buses and throw-over switches.

The arrangement of the busbar system resembles somewhat that

of a steam header, the several generators feeding into the various sections of the bars just as several boilers feed into various sections of the header; the feeders taking current from the bars just as engines take steam from the header; and the bars being divisible by knife switches just as a header is divisible by gate valves, by means of which any one section can be cut off for separate service or for repairs or changes.

The general scheme of the circuits is indicated by Fig. 18, a diagram in which for simplicity's sake all three phases are represented by one line. It will be seen that the generators are divided into four sets, three of which contain three machines each and the fourth the other two machines of the eleven. It will also be noted that the common lead from the first group of generators, Nos. 1, 2 and 3, is connected through a knife switch to a short intermediate section of the busbars, one end of which may be connected by a knife switch to the left-hand main section, No. 1, of the buses, while the other end goes to a knife switch leading to a similar short intermediate section to which current is also introduced from the second group of generators, Nos. 4, 5 and 6. The right-hand end of this second intermediate section goes to another section, No. 2, of the main buses. The connections of the two groups of machines at the extreme right are rendered clear from the drawing without further explanation.

The power passes from the busbars to what are termed "group"

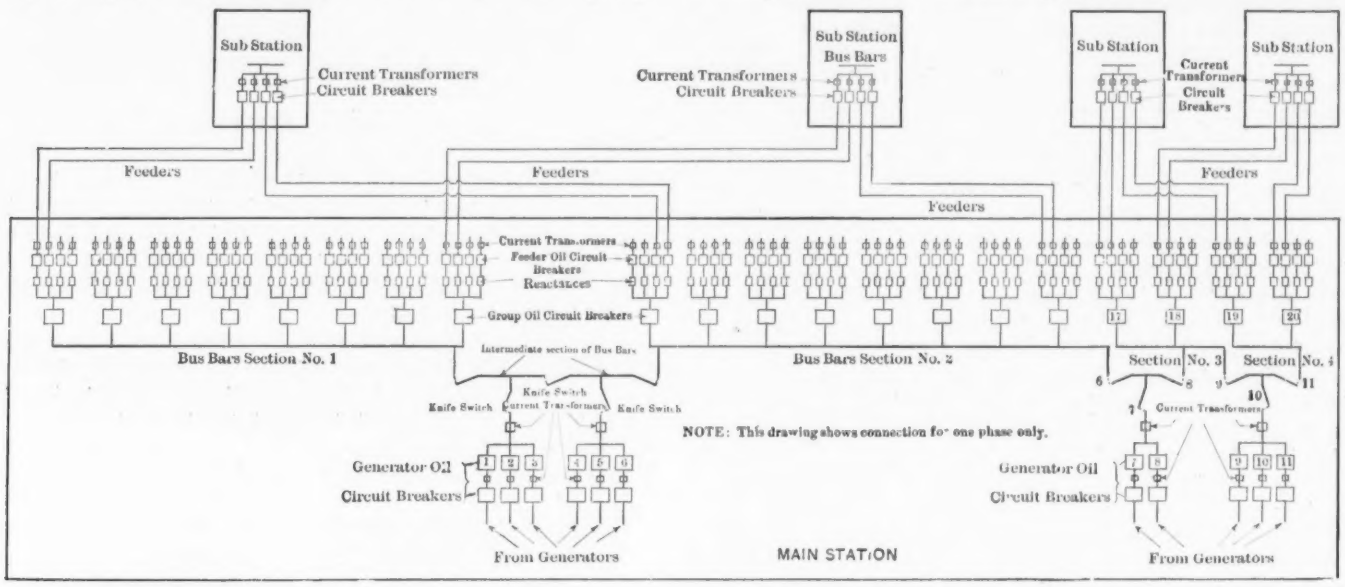


FIG. 18.—DIAGRAM SHOWING THE GENERAL PLAN OF CONNECTIONS FROM THE GENERATORS TO THE SWITCHBOARD, AND FROM THE SWITCHBOARD TO THE FEEDERS.

breakers, which are oil breakers of 800 amperes capacity similar to those used on the generator leads. From each of these group breakers the current goes to four feeder breakers, from which it passes out via the feeders to the substations. The several feeders running to each substation are connected in to group breakers on different sections of the busbars, so that in case any one section of the bars is shut down all of the substations will continue to receive current from other sections.

The several cables to each substation follow so far as possible different routes under the streets, so that in case of a burn-out or other fault involving an entire conduit no station will be completely cut off.

Electroplating Baths without Water.

C. F. Burgess, in a paper read at the March meeting of the Chicago Electrical Association, referred to the desirability of an electroplating bath containing no water, which would obviate difficulties encountered in working with certain metals owing to the presence of hydrogen released from the water. Recent experimental research has shown, he says, that it is possible to dissolve certain metallic compounds in certain organic substances, and that such solutions may be electrolytes. Some notable work along this line has been carried on very recently by Dr. L. Kahlenberg, of the University of Wisconsin. He has succeeded in obtaining very good deposits of lithium, a metal which under ordinary circumstances would be considered even more difficult to deposit than aluminum or magnesium. His method consisted in dissolving lithium chloride in pyridine, a somewhat volatile organic compound, and passing the current through the solution, as in the ordinary plating operation.

Schemes for the Application of Electric Traction to Railway Lines in Italy.

BY GIOVANNI GIORGI.

ACTIVE steps are now being made toward replacing steam by electricity on many Italian trunk railways, especially lines with many tunnels, where smoke is objectionable, or where water power is available. The chief companies interested in these schemes are the Mediterranean Railway Company (Società delle Strade Ferrate Meridionali), and the Adriatic Railway Company (Società delle Strade Ferrate Meridionali), which control respectively the western and eastern part of the railway network of the kingdom.

The first attempt was made by the last mentioned company, and had mainly an experimental object. It consisted in the substitution of electric for steam traction on the Milano-Monza line. The inauguration of the electric service took place at the beginning of the year 1899, and since then has been continuously working. We give a brief account of the particulars of this plant.

The Milano-Monza line is about eight miles long, and the electric service is done exclusively by motor cars. On the same line also the ordinary steam trains continue to perform a part of the service, especially for freight. The power house is in Milan, and contains a Schuckert rotary transformer, fed from the three-phase circuit of the town, and having an output of 67-kw direct current at 250 to 350 volts.

The line is operated by batteries on the motor cars. Each motor car is equipped with a battery of 65 cells, connected in series, and having sufficient capacity for running a distance of 31 miles at a speed of 29 miles per hour. The weight of the car, empty, is 58 tons, including the batteries, and the car has accommodation for 64 seated and 26 standing passengers; at each end there is a cab for the motorman. The motor equipment consists of two 50-hp single-reduction series-wound motors, with double spring suspension. The cars are of the double-truck or pivoted type, and each truck has a motor coupled to one of the two axles. The whole electrical equipment has been supplied by the Schuckert Company, of Nurnberg, and the complete cars by Messrs. Grondona, Comi & Co., of Milan.

A speed of 38 miles has been reached without difficulty. Since its inauguration this plant has been in daily service continuously and has given perfect satisfaction. This was a small installation, executed for experimental purpose in order to see whether the technical difficulties of the application of electricty to steam railway were really overcome. Its success has decided the company to carry forward larger schemes of a more industrial character.

The first is a project involving the electric operation of the existing trunk line in Valtellina. These are the lines of Lecco-Colico, Colico-Sondrio and Colico-Chiavenna, up to the Swiss stations. The aggregate length of these lines, which have a considerable international importance, is 83 miles, and they follow the Alps valleys. The lines are now operated by steam. The application of electricity will

make it possible to employ the power of the waterfalls, of which there is such a plenty in that region. About six months ago the Adriatic Company asked the approval of the Italtian government for this scheme. This has been granted and a royal decree has lately confirmed an agreement between the government and the company authorizing the transformation. The works are already in progress, and the inauguration ought to take place before October, 1901. The scheme adopted, as lately modified, is the following:

The hydraulic power will be derived from a 98-foot waterfall of the River Adda, from which the company has a concession for deriving a stream of 25 cubic meters per second. The river is tapped at a point near the bridge of Desco and the stream is conducted by a tunnel three miles long to Morbegno, ten miles from Colico, where 10,000 hydraulic horse-power will be thus rendered available. The power house will contain three or four units, each unit consisting of a 2000-hp reaction turbine direct-coupled to a Ganz three-phase alternator of 2000 kilovolts-amperes capacity at 15,000 volts with a frequency of 15 periods per second.

The line poles will be erected along the railway, and the primary and secondary line will be mounted on the same poles, but kept apart in the tunnels on account of the more difficult insulation there. The primary line will be equipped with triple petticoat porcelain insulators. Along the line are distributed the secondary transforming stations at a distance of 8 miles from each other. The working conductors are of 8-mm diameter and will carry a pressure of 3000 volts.

The motor cars for passenger service will be equipped with four motors of 150 maximum horse-power; those for freight service, with four motors of 250 maximum horse-power. The motors will be arranged in such wise as to keep two motors only in circuit at maximum speed, the other two being thrown in when it is necessary to obtain the maximum torque with lower speed. The maximum speed will be 40 miles per hour with a train of 65 tons on a grade of 10 per 1000, and about 65 miles per hour with the motor car alone on a level. The plan contemplates the simultaneous operation of five passenger trains and two freight trains on the line. The whole power required will average 2500-hp on the trains. Reckoning on an efficiency of 65 per cent., this will correspond to about 3500-hp at the central station. A surplus of 3000 to 4000-hp will remain available at the central station, and the company will distribute it by three-phase currents to the towns of the valley.

It has been decided that the plans of this important scheme are to be exhibited at the Paris exhibition, together with some electric cars. A part of the rolling stock is already near completion.

The Adriatic Company is now contemplating further schemes of electric traction, especially on the mountain trunks of its lines, which are numerous. On such trunks there are a number of long tunnels, where steam operation is highly objectionable, while water powers are easily available at near points along the lines. The most important trunk to which these conditions apply is the line, Bologna-Firenze, crossing the highest points of the chain of Appenines. This is several hundred miles long, has deep gradients, and is a main line for the traffic between Southern and Northern Italy. Schemes for this and other important lines will be presented after completion of the equipment of the first described lines.

Similar schemes have been carried out by the Mediterranean Company. This has placed an application before the Central Committee, asking for the concession of the water power of the River Tusciano in the Valle Silentina. The committee has finally handed down its decision, according to which a royal decree has granted to the company the concession of 10,500-hp, for the operation of the main lines in the Provinces of Naples and Salerno, under the condition that the company will start within two years the works for their utilization. The remaining power of the same river and the whole of Sele and other rivers will be sold to private industry.

Following this decision, the railway company has presented its scheme for the electric operation of the trunk line Napoli-Castellammare di Stabia, a line of heavy traffic. It is without grades and runs along the seashore and Mount Vesuvius, and is double tracked, being 22 miles in length. The power will be temporarily supplied by a steam power station, to be erected at Torre-Annunziata, near one end of the trunk, and the line thus operated until completion of the transmission from Tusciano, when the steam power house will remain as a reserve.

The trunk line will be equipped on the third rail system, and operated probably at 500 volts pressure. The service will be arranged not unlike that of the Milano-Monza line, making an express departure every two hours, and ordinary passenger trains every forty minutes. The trains will consist of a motor car alone or with one or two trailers.

The cost of the equipment is estimated as follows: About $120,000 for eight complete motor cars; about $440,000 for the power house, line and appliances, and about $117,000 for the third rail. The express trains will have an average speed of 40 miles, including stoppages.

Another scheme nearing execution is that for the construction and electric operation of an international line from Varese to Luino, 18 miles long. A royal decree has confirmed an agreement with the "Società delle Ferrovie Varesine" granting a yearly contribution, and the company has deposited a sum of money in order to guarantee that the works will be completed by June, 1901. The cost of this plant is estimated at $137,000.

A few months ago a company was organized in Rome which is affiliated with the "Compagnie Thomson-Houston," agents of the General Electric Company in Europe. It has the object of constructing and operating many suburban railways, especially in the Province of Rome. It is proposed to extend these by steps until they branch out a considerable distance. This company has already prepared schemes for an electric railway 20 miles long from Rome to Ostia, affording a rapid connection between Rome and the seashore; and another of about the same length from Rome to Frascati. Both these lines will be operated only by express service.

An Electric Phonograph.

By T. Chr. Steenberg.

In Denmark quite a notable improvement has recently been made in the phonograph as invented by Edison. The new phonograph has been called by its inventor, Valdemar Paulsen, a Danish engineer, the telegraphone, a description of the construction and use of which follows. Mr. Paulsen has been experimenting with the invention for several years, but only recently succeeded in perfecting it sufficiently for practical use.

The new and important feature embodied in this phonograph is that instead of the Edison wax cylinder for receiving and reproducing speech, Mr. Paulsen substitutes a steel band or steel wire. Moreover, this type of phonograph is intended to be used only in connection with a telephone.

The steel band referred to passes between the poles of a small

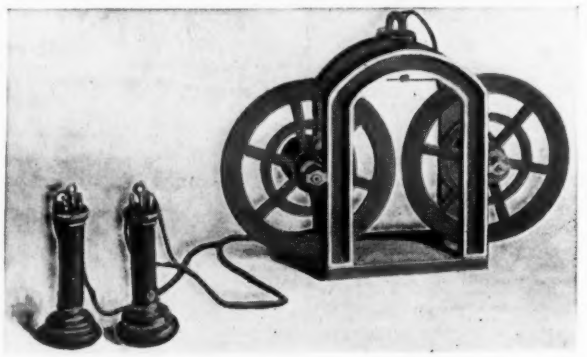


FIG. I.—ONE FORM OF TELEGRAPHONE.

electromagnet, the coil of which is connected with a telephone. The pulsations of the current caused by speaking into the telephone varies the strength of the electromagnet, which in turn affects the magnetism of the steel band. The band is thus variably magnetized at different portions of its length, corresponding to the variations of the speech current, and will keep in this state for a long period. When again passed between the poles of the same or similar electromagnet, it reproduces the initial variations of current, and the speech is again heard through the telephone. In this way the steel band can be used to reproduce the message a great number of times.

When it is desired to use the telegraphone to receive a new message, all that is necessary is to pass the band between the poles of a strong electromagnet or to send an electric current through it. Then all the magnetism of the steel band will disappear and it will be again ready for use.

A difficulty which at first militated against the practical use of the invention, was that in order to receive a speech of any considerable length it was necessary to use a very long steel band. This drawback, however, was overcome by Mr. Paulsen's assistant engineer,

Mr. Petersen, who added to the apparatus another invention which makes it possible to record several messages on the same steel band without causing any confusion in the reproduction of the same. The experiments thus far made have shown that the new telegraphone reproduces speech and singing very distinctly and exactly in the same tone as given.

The illustrations are photographic reproductions of two of the first instruments made. Fig. 1 shows a steel band wound around one of two wheels. In running from one wheel to another, it comes in relation with the electromagnet on top of the frame and is acted upon by it. The band is then drawn back upon the first wheel, and is now able, by duplicating the original motion, to reproduce the speech in the telephone, and to do so as often as is required. Fig. 2 shows

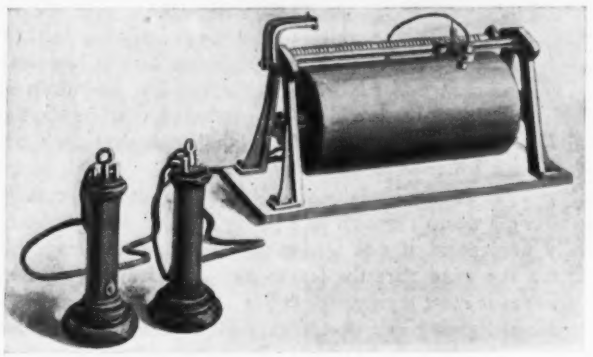


FIG. 2.—ANOTHER FORM OF TELEGRAPHONE.

another form of instrument, more in appearance like the Edison phonograph. The electromagnet is here shown traveling along a steel or nickel wire wound in a spiral around a drum.

It is proposed to use the instrument in connection with telephone central stations, and it is already thus used in several places in Denmark. As an example of this application, the case will be considered of a telephone subscriber, *A*, who leaves his office, after having adjusted his instrument to receive messages during his absence, and also answer any inquiries concerning the time he will be back. *B*, another subscriber, rings him up. The telegraphone is put into action by the ringing up, and tells that *A* is not in, but that it will be pleased to receive the message for him. When this is received, *B* rings off and the telegraphone goes out of action. This can be repeated a number of times, and the messages then read by *A* when he returns. Such an arrangement has been introduced at Copenhagen, and is said to work satisfactorily.

Canadian Water Power Development.

The Ontario Power Company on April 11 signed a contract of agreement with the Commissioners of the Queen Victoria Niagara Falls Park for the development of power on the Canadian side of the Niagara River. The company's plans contemplate the immediate development of from 30,000 to 60,000-hp, which can be readily increased to meet the demand for power up to 300,000-hp.

It is estimated that the cost of the development of 30,000-hp will be $2,000,000. The plan is to bring the water from the Welland River at the point where it enters the Niagara River, by a canal to a bluff below the Dufferin Islands, where the first 60,000-hp will be developed. The water will be carried thence by an open canal through the park to a point just below Table Rock, where, under a head of 160 feet, 240,000-hp will be available.

The company expects to deliver the first power in about eighteen months, and it will be used for electrolytic work and other industries, including a large steel plant, all of which will be located on the company's grounds, which comprise about 2000 acres. It is stated that applications have already been filed for 60,000-hp.

The company has paid over $30,000 in advance for two years' rental. The gentlemen who are associated in this enterprise are prominent citizens of Buffalo. Mr. J. J. Albright is the president; Gen. Geo. S. Field, vice-president, and in charge of the active management. Other associates on the directorate are Edmund Hayes and Franklin D. Locke, Buffalo; Henry C. Symmes and Banker R. Payne, Niagara Falls, Ont.; William German, M. P., Welland, Ont., and Arthur C. Denniston, Philadelphia, Pa. The company will use standard apparatus in all its work.

The Elements of Illumination—II.

By Dr. Louis Bell.

ALTHOUGH a measure of intrinsic brightness is obtained by dividing the candle-power of any light by the area of the luminous surface, this latter quantity is very difficult to determine accurately since with the exception of the incandescent filament no source of light is anywhere nearly of uniform brilliancy over its entire surface. For the sake of comparison we can, however, draw up an approximate table by assuming equal brightness over the generally effective lighting area of any light. It should be distinctly understood that the values tabulated are only average values of quantities, some of which are incapable of exact determination and others of which vary over a wide range according to conditions.

INTRINSIC BRILLIANCIES IN CANDLE-POWER PER SQ. IN.

Source—	Brilliancy.	Notes.
Sun in zenith	600,000	Rough equivalent values, taking account of absorption.
Sun at 30 degrees elev.	500,000	
Sun on horizon	2,000	
Arc light	10,000 to 100,000	Maximum about 200,000 in crater.
Calcium light	5,000	
Incandescent lamp	200-300	Depending on efficiency.
Melting platinum	130	1 sq. cm. = 20 c.p.
Enclosed arc	75-100	Opalescent globe.
Welsbach light	20 to 25	
Kerosene lamp	4 to 8	Very variable.
Gas flame	3 to 8	Very variable.
Candle	3 to 4	
Incandescent (frosted)	2 to 5	
Opal shaded lamps, etc.	0.5 to 1	

The striking thing about this table is the enormous discrepancy between electric and other lamps of incandescence and flames of the ordinary character. The very great intrinsic brilliancy of the glow lamp is particularly noteworthy and from the oculist's standpoint menacing.

Every one is familiar with the distress caused the eye by sudden alternations of light and darkness, as in stepping from a dark room into full sunlight, or even in lighting the gas after the eye has become habituated to the darkness. The eye is provided with a very wonderful automatic "iris diaphragm" for its adjustment to various degrees of illumination, but it is by no means instantaneous, although very prompt in its action. Moreover the eye after resting in darkness is in a very sensitive and receptive state and a relatively very weak light will produce very noticeable after-images. These after-images, such as are seen in vivid colors after looking at the sun, are due to retinal fatigue.

If the image of a brilliant light is formed upon the retina, it produces certain very considerable chemical changes akin to those produced by light upon sensitized paper. In so doing it temporarily exhausts or weakens the power of the retina to respond at that point to further visual impressions, and when the eye is turned away the image appears, momentarily persistent, and then reversed, dark for a white image and for a colored one of the complementary hue. This after-image fades away more or less slowly according to the intensity of the original impression, as the retina recovers its normal sensitiveness.

A strong after-image means a serious local strain upon the eye, and shifting the eye about when brilliant light can fall upon it implies just the same kind of strain that one gets in going out of a dark room into bright sunshine. The results of either may be very serious. In one case recently reported a strong side light from an unshaded incandescent lamp set up an inflammation that resulted in the loss of an eye. The light was two or three feet from the victim, whose work was such that the image of the filament steadily fell on about the same point on the retina, at which point the resulting inflammation had its focus. A few weeks exposure to these conditions did the mischief. This is an extreme case, but similar conditions may very quickly cause trouble. A year or two since the writer was at lunch facing a window through which was reflected a brilliant beam from a white painted sign in full sunlight just across the street. No especial notice was taken of this until on glancing away a strong after-image of the sign appeared, and although the time of exposure was only ten or fifteen minutes, the net result was inability to use the eyes more than a few minutes at a time for a fortnight afterwards.

To a certain extent the eye can protect itself from too brilliant general illumination by closing up the iris, and it always does so, reducing the general brightness of the retinal images, as one regulates the illumination on a photographic plate. But a light of great intrinsic brilliancy produces so strong an image that it may cause

trouble even when the aperture of the eye is stopped to the utmost limits provided by nature. In the effort to accomplish this adjustment the iris closes so far when a brilliant light is in the field of vision that the rest of the field is dimmed so far as to interfere with proper vision, quite aside from any question of fatigue induced by the bright image wandering over the retina as the eye is shifted.

In general terms the iris adjusts itself with reference to the brightest light it has to encounter so that if there is in the field of vision a source of light of great intrinsic brilliancy the working illumination may be highly unsatisfactory. The same principle coupled with retinal fatigue accounts for one's inability to see beyond a brilliant light, as in driving towards an arc lamp hung low over the street.

A very simple experiment showing the effect of a brilliant source of light on the apparent illumination may be tried as follows: Light a brilliant lamp, unshaded, in a good-sized room, preferably one with darkish paper. Then put on the light an opal or similar shade. It will be found that the change has considerably improved the apparent illumination of the room, although it has really cut off a part of the total light. Moreover at points where there remains a fair amount of illumination the shade has improved the reading conditions very materially. If one is reading where the unshaded light is at or within the edge of the field of vision, the improvement produced by the shade is very conspicuous. Lowering the intrinsic brilliancy of the light has decreased the strain upon the eye and given it a better working aperture.

As a corollary to these notes on the effect of bright lights on our visual apparatus should be mentioned the fact that sudden variations in the intensity of illumination seriously strain the eye both by fatigue of the retina by sudden changes from weak to strong light, and by keeping the eye constantly trying to adjust itself to changes in light too rapid for it properly to follow.

A flickering gas light, for example, or an incandescent lamp run at very low frequency, strains the eye seriously and is liable to cause temporary, even, if not permanent injury.

The persistence of visual impressions whereby the retinal image remains steady for an instant after the object ceases to affect the eye, furnishes a certain amount of protection in case of very rapid changes of brilliancy. It acts like inertia in the visual system.

In the case of arc and incandescent lamps the thermal inertia of the filament or carbon rod also tends physically to minimize the changes, but with a low frequency alternating current they may still be serious.

The exact frequency at which an incandescent lamp on an alternating circuit begins to distress the eye by the flickering effect depends somewhat on the individual eye and somewhat on the mass of the filament. In general, a 16-cp lamp of the usual voltages, say 100 to 120, begins to show flickering at or even a little above 30 ~ per second, one foreign authority putting it as high as 40 ~. At 25 ~ the flickering is troublesome to most eyes, and at 20 ~ or below it is generally quite intolerable. In looking directly at the lamp the filament is so dazzling that the fluctuations are not always in evidence at their full value, and a low frequency lamp is quite likely to be the source of trouble to the eye even when at first glance it appears to be quite steady.

Lamps having relatively thick filaments can be worked at lower frequencies than those of the common sort, so that 50-volt lamps, particularly of large candle-power, may be worked at 30 ~ or thereabouts, rather well, perhaps even down to 25 ~. That is, at a pinch one can do satisfactory work when current is available at 25 ~ or so, by using low voltage lamps of 32, 50 or 100-cp, which, by the way, are capable of giving admirable results in illumination if properly disposed. Of course, such practice is bad in point of efficient distribution of current, but on occasion it may be useful.

As to arc lamps, conditions are not so favorable. The fluctuations of an alternating arc lamp are easily detected even at 60 ~ by moving a pencil or the finger quickly when strongly illuminated. The effect is a series of images along the path of motion, corresponding to the successive maxima of light in the arc. At 40 to 45 ~ the flickering becomes evident even when viewing stationary objects, the exact point where trouble begins depending upon the adjustment of the lamp, the hardness of the carbons, and various minor factors. Enclosing the arc mitigates the difficulty somewhat, but does not remove it.

In working near the critical frequency the best results are attained by using an enclosed arc lamp taking all the current the inner globe will stand, with as short an arc as will work steadily.

Where polyphase currents are available, as is usually the case where rather low frequencies are involved, some relief may be obtained by arranging the arcs in groups consisting of one from each phase. At a little distance from such a group the several illuminations blend so as to partially suppress the fluctuations of the individual arcs. This device makes it possible to obtain fairly satisfactory lighting between 35 and 40 ~. At these frequencies, however, the arcs should not be used except when a very powerful light is necessary or when the slightly yellowish tinge of incandescents would interfere with the proper judgment of colors. Powerful incandescents are generally better and are but little less efficient, particularly when one takes into account proper distribution of the light. These fluctuations due to low frequency are very distressing to the eye and should be sedulously avoided. Fortunately, save in rare instances, the frequency can be and should be kept well above the danger point.

The same considerations which forbid the use of very intense lights unshaded, flickering lights and electric lights at too low frequency render violent contrasts of brilliant illumination and deep shadow very objectionable. It should be remembered that in daylight the general diffusion of illumination is so thorough that such contrasts are very much softened, even in full sunlight, and much of the time the direct light is modified by clouds. In the cases where the sun shines strongly down through interstices in thick foliage the effect is decidedly unpleasant if one wishes to use the eyes steadily, and if in addition the wind stirs the leaves and causes flickering the strain upon the eyes is most trying.

In artificial lighting one should carefully avoid the conditions that are objectionable in nature, which can easily be done by a little foresight. If for any purpose very strong illumination becomes necessary at a certain point the method of furnishing it which is most satisfactory from a hygienic standpoint is to superimpose it upon a moderate illumination well distributed. If a brilliant light is needed upon one's work start with a fairly well lighted room and add the local illumination, instead of concentrating all the light on one spot. This procedure avoids dense shadows and dark corners, and enables the eye to work efficiently in a much stronger illumination than would otherwise be desirable.

It should not be understood that the complete abolition of shadows is desirable. On the contrary, since much of our perception of form and position depends upon the existence of shadows, the entire absence of them is troublesome and trying. This is probably due to two causes. First, the absence of shadows gives an appearance of flatness out of which the eye vainly struggles to select the wonted degrees of relief. In a shadowless space we have to depend upon binocular vision to locate points in three dimensions and the strain upon the attention is severe and quickly felt.

Second, the existence of a shadowless space presupposes a nearly equal illumination from all directions. If it be strong enough from a particular direction to be convenient for work requiring close attention of mind and eye, then if there be no shadows equally strong light will enter the eye from directions altogether unwonted. This state of things we have already found to be objectionable in the highest degree.

The best illustration of this latter condition may be found in nature during a thin fog which veils the sun while diffusing light with very great brilliancy. Try to read at such a time out of doors, and although there is no direct light on the page to dazzle you, and there is in reading no trouble from the sense of flatness, yet there is a distinctly painful glare which the eyes cannot long endure without serious strain.

In artificial lighting the same complete diffusion is competent to cause the same results, so that while contrasts of dense shadow and brilliant light must be avoided it is generally equally important to give the illumination a certain general direction to relieve the appearance of flatness and save the eye from crosslights.

Telephone, Telegraph and Cable Business Under One Management.

President C. J. Glidden, of the Erie Telephone system, recently made a tour of inspection in the southwest. While in Galveston, Tex., he is reported to have made the statement that inside of five years the telephone, telegraph and cable business of the country would be consolidated under one management, employing a capital of $250,000,000.

The Production of Asymmetrical Alternating Currents by Means of Electrolytic Polarization—II.

BY W. L. HILDBURGH.

(Concluded.)

SINGLE-CELL RECTIFIERS.

In a preceding article the theory of two-cell rectifiers was considered. A single-cell rectifier is a device containing only one electrolytic element, which will asymmetrically affect an alternating current. Rectifiers depending on the resistance effects at the surface of aluminum electrodes will not be considered here, only cells acting by the production of counter e. m. fs. being discussed. If two electrodes differing in composition be immersed in an electrolyte one electrode may be considered as inert, since, even if it be ordinarily soluble in the electrolyte the presence of the second, and more soluble, electrode in the circuit will prevent its solution.

Certain metals are ordinarily insoluble in certain acids, as copper in dilute H_2SO_4, their solution pressures in solutions of their own salts being less than that of hydrogen in a solution of its corresponding salt. If such a metal be used as anode, with a platinum cathode, it will dissolve freely and liberate a quantity of energy which will be taken up in the production of hydrogen bubbles at the inert electrode. There will be a counter e. m. f. due to the excess energy necessary to liberate the hydrogen, and equal to the algebraic sum of the potential differences at the two electrodes. The more nearly equal those potential differences the lower the counter e. m. f.

When the soluble metal acts as cathode the hydrogen previously deposited on the platinum will dissolve, and metal be deposited on the soluble electrode. When the hydrogen is all removed from the inert plate oxygen will be deposited, and the counter e. m. f. of the cell be equal to the sum of the potential differences of the oxygen in H_2SO_4 and of the soluble metal in a solution of its sulphate. Until the impressed e. m. f. is high enough to overcome the counter e. m. f. representing that sum no continuous current can flow, but only a quantity of energy sufficient to charge the inert plate and produce a counter e. m. f. equal to the impressed. The cell gives in one direction a counter e. m. f. equal to the difference between the potential differences of the soluble electrode and a substance deposited on the inert electrode, and in the opposite direction an e. m. f. equal to the sum of the potential differences of the soluble electrode and of some second substance deposited on the inert electrode.

The soluble electrode gives an e. m. f. fixed in value and direction, and independent of any quantity of current passed into or out of it; its capacity may therefore be regarded as infinite. The potential difference at the inert electrode depends on the direction and value of the impressed e. m. f. The theory of a rectifier of this kind is consequently the same as that of a two-cell rectifier in which one of the plates is of infinite area, and all deductions for the latter hold true for the former. The potential difference at the soluble electrode is the equivalent of the active e. m. f. in the two-cell rectifier, the two differences at the inert electrode the equivalents of the passive e. m. f. In the two-cell rectifier the active and the passive e. m. fs. are, for the best results, equal. In the single-cell rectifier there is no definite ratio between them, and one of the passive e. m. fs. may be any number of times greater than the active; the active e. m. f. may even be zero, as in some of the two-solution rectifiers.

An electrolyte when used in the decomposition cell of a two-cell rectifier permits the economical use of an impressed e. m. f. just double that permissible when it is used in a single-cell rectifier, the active e. m. fs. in both cases being balanced; in the latter the sum of the active e. m. f. and the passive e. m. f. in the "useless" direction is the decomposition value of the electrolyte, half the maximum counter e. m. f. obtainable in the former.

To exactly balance the active e. m. f. and the passive e. m. f. in the "useful" direction alloys may be used for the soluble electrode, or the pressure at the inert electrode varied. The best method of balancing is by the use of an external source of e. m. f. to aid or oppose the active e. m. f., according to whether the latter is too high or too low. The potential difference at the soluble electrode and that in the "useful" direction at the inert electrode may be considered as the active and passive e. m. fs. of a two-cell rectifier, with respect to their relative values. When the potential difference at the soluble electrode is the greater the cell will be an ordinary primary cell giving a continuous current.

As an electrolyte dilute sulphuric acid seems most suitable, with hydrogen, copper, silver, lead, mercury, etc., as soluble electrodes. With lead* and mercury,† secondary actions occur which interfere seriously with their use in cells having a small inert electrode, though they make it possible to obtain very slight asymmetrical effect when the inert electrode is large. A cell consisting of two large plates, lead and platinum, in dilute H_2SO_4 gave a curve which showed a difference in the two leads (first and second half-waves), but practically no other indication of asymmetry. With a small platinum plate the efficiency was apparently about 6 per cent., but the curve as taken was very irregular and entirely untrustworthy, due to the continual changes going on at the surface of the lead.

Curves were traced from cells having copper, hydrogen, iron, and zinc, as active electrodes, in solutions of sulphuric acid or their sulphates, the inert electrode being of platinum in dilute sulphuric acid. In the copper cells the active e. m. f. is too low, in the hydrogen cell almost right, and in the others too high. Aluminum differs from most other metals because of the peculiar resistance effect at its surface, but can be used as a soluble metal in a heated solution or if the hydrate be continually removed; the active e. m. f. is considerably higher than the passive, and the action consequently uneconomical. When the resistance effect is utilized the current is rectified in the opposite sense.

If the salt solution formed about the active electrode be not removed the cell becomes a two-fluid cell, to be described later. The ideal cell is one in which the electrolyte is a solution of a compound of the active metal, the substance (in the "useful" direction) then being the same at both electrodes. The soluble material must then be a gas, discharging freely, or the passive electrode will be quickly covered with active metal and cease to be inert. Hydrogen, oxygen, or chlorine, when occluded by platinum black, will act as gaseous electrodes, hydrogen in H_2SO_4 giving by far the best results. Oxygen can better be used in acid solutions in the form of peroxide of manganese or

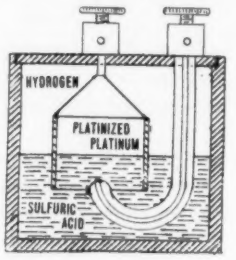


FIG. 4.—HYDROGEN-CELL RECTIFIER.

lead, or in alkaline solutions as oxide of copper, the current then passing freely from the inert plate as anode.

A long series of experiments was tried with the cell H_2 — H_2SO_4 — Pt,‡ the hydrogen electrode consisting of platinized platinum partly in the gas, partly in the electrolyte. The direct impressed e. m. f., as in experiments on other rectifiers, was furnished by several small gravity cells; an alternating e. m. f. was obtained by passing the direct through a commutator, provided with slip rings, on the shaft of a small motor. A 600-V Weston voltmeter, connected on the calibrating coil (113 ohms) served as an ammeter. Before the hydrogen was allowed to enter the platinum the asymmetrical effect was almost nil; immediately after entrance it rose to a high figure. The reading dropped slowly when the platinum was entirely immersed. A large bottle provided with electrodes and inlet and outlet tubes was used for trying the effect of hydrogen in H_2SO_4, oxygen and air in acid and alkaline solutions, chlorine in hydrochloric acid and chlorine water, and illuminating gas in H_2SO_4; the hydrogen alone gave satisfactory results.

With hydrogen the area of the large electrode was found to affect the results, the reading at starting generally being somewhat higher than after a few minutes' running. Platinum foil coated with palladium black gave the most constant results. A small loss of efficiency, due to age, has been found to be produced by a gradual covering of the inert electrode, with finely divided platinum. The hydrogen cell is slightly underbalanced, the amount varying with the size of the inert electrode, the concentration of the electrolyte, etc.

Numerous experiments were tried with carbon as the hydrogen

*Sheldon and Waterman, *Phys. Rev.*, Vol. IV., p. 324, Jan., 1897.
†Lowrie-Hall, *Lon. Elec.*, Vol. XXI., p. 157, June 8, 1888.
‡See Fig. 3 in Part I. for current curves of this cell.

absorbent. Gas-carbon, plain or charcoal coated, drawing charcoal and fuel charcoal were used, but the results appeared to show no effect due to the hydrogen atmosphere. Asymmetrical effects were produced, but it was concluded that they were due principally to resistance actions at the anode; it was found that the higher the impressed e. m. f. the greater the difference between the + and — readings, and that diluting the electrolyte lowered the higher readings and greatly raised the lower, the impressed e. m. f. being 4 volts. By heating charcoal and plunging it into water or dilute acid excellent electrodes were obtained, but their effect was found to be mostly, if not entirely, due to hydrogen generated within the pores by the action of the red hot carbon on water. Curves with the carbon electrodes were plotted, but showed no particular features of interest; the A. E. was negligibly low in all but one cell, in which quenched charcoal formed the electrode.

Single-cell C's adapt themselves particularly well to a "continuous-acting" construction, avoiding the wasting of the active cell in the two-cell rectifier, or of the active electrode in the ordinary single-cell form. Continuous-acting cells are made self-regenerating by causing the substance discharged from the passive electrode to return, by gravity or otherwise, to the active electrode whence it came. A typical, simple and very satisfactory form is shown in Fig. 4, consisting of a sealed jar of dilute H_2SO_4 containing a small platinum electrode and a large platinized electrode whose upper portion is in hydrogen gas.

The "useful" current carries hydrogen from the large to the small electrode, at which it is given off in bubbles which return to the hydrogen atmosphere above, thence to be reabsorbed by the large electrode. In the "useless" direction oxygen is concentrated at the small electrode, but not given off unless the impressed e. m. f., the frequency and the external resistance are such as to raise the counter e. m. f. of the cell to about 1.67 volts. As long, therefore, as the impressed e. m. f. is kept sufficiently low the hydrogen atmosphere will remain pure, and the counter e. m. f. of the cell be a few hundredths of a volt in one direction, and 1.67 volts in the opposite direction. By reducing the atmospheric pressure in the cell the excess e. m. f. necessary to the formation of hydrogen bubbles may be reduced, while but slightly lowering the active e. m. f. Increasing the pressure has the reverse effect, but the advantage of decreasing the necessary size of the large electrode. The large electrode need only be of sufficient area to absorb the hydrogen as rapidly as it is produced at the small electrode. The electrodes can be brought as near together as desirable, leaving just room for the escape of bubbles, though the tendency is then for only the part of the large electrode directly opposite the small to act. This disadvantage may be avoided by dividing the inert electrode into a number of parts, thus reducing the resistance and facilitating the discharge of bubbles, and by the tendency of the hydrogen to flow from the charged to the uncharged part of the plate.

Gee and Holden* have investigated resistance effects at a small anode which are absent when the cathode only is small. Fromme† has found a higher polarization possible with a small anode and large cathode than when the reverse is the case. The difference in the polarization attainable with smooth and platinized electrodes has been shown by Glaser‡ to be almost entirely due to the anode actions. These three effects act in the same direction as the main effect, increasing the asymmetrical efficiency.

Continuous-acting two-cell rectifiers can be constructed by using a U-tube as the decomposition cell, the atmosphere above the electrolyte in each leg being in communication with the atmosphere about one of the electrodes of a hydrogen-oxygen gas battery. The electrolytes in the two cells must be insulated from one another, as by paraffining the interior of the tubes connecting the atmospheres. The active e. m. f. is about 1.07 volts, the passive 1.67. Water is continually carried from the decomposition cell to the gas battery; it may be replaced by gravity without breaking the seal, by tipping the rectifier. The arrangement is clumsy and has many disadvantages.

Cells having two electrodes differing in composition dipping into two different electrolytes in electrolytic communication may be divided into three classes: The active electrode may be in a solution of one of its own salts, the passive in a solution of a salt of some other metal; the active electrode may be in a solution of a salt of some other metal, the passive in a solution of a salt of the active metal; or both electrodes may be in solutions other than that of the active metal. The first of these classes is of great importance, the others, though interesting, of but little. To the first class belong the two-fluid primary cells, in which the active is greater than the passive e. m. f. By lowering the active e. m. f. sufficiently a rectifying cell is produced which gives no current, whose theory is the pure theory of a two-cell rectifier having a finite and an infinite electrode, and which is equivalent to a single-liquid single-cell rectifier in which the salt formed about the soluble electrode is allowed to remain. The advantage of this type of cell is that it is possible to use a solid active electrode, and still have a gas as the substance deposited at the passive electrode. The cells having copper, iron, and zinc electrodes, described for simplicity under one heading with single-solution cell, really belong to the class under present consideration.

Balancing may be done as previously described. Electrodes of two soluble metals in solutions of their salts will not form a rectifier; if the potential differences are unequal a continuous current will flow, if equal none, in either case the alternating current passing unchanged because both electrodes are perfectly reversible and of practically infinite capacity.

Rectifiers may be constructed both of whose electrodes are inert, but dip into electrolytes differing in composition or concentration. In the cell Pt — H_2SO_4 — Conc. HNO_3 — Pt the "useless" current deposits H in H_2SO_4 and O in HNO_3, and the "useful" O in H_2SO_4 and nothing in HNO_3, the H being taken up by the HNO_3. The counter e. m. f. in the first instance is consequently considerably greater than in the second. The same general principles govern the size of the electrodes as in rectifiers having active and passive plates. The HNO_3 forms an irreversible electrolyte, it being possible to decompose, but not to recompose it electrolytically, and its action on the cathode is the equivalent of the giving off of hydrogen bubbles without the production of counter e. m. f. The action of the cell in one direction is that of a condenser having both plates of finite size, in the opposite direction that of a cell having one plate infinitely large; that is, one half-wave and a part of the succeeding one are choked down as if there were two electrostatic condensers in series, while the remainder of the second half-wave passes as if only one condenser were left in circuit. There is a resistance effect due to the formation of bubbles, which aids the e. m. f. effect, though small as compared with it. Dilute HNO_3 can be used in the place of the H_2SO_4 without greatly affecting the results.

Very curious results follow the use of a platinized electrode in the concentrated nitric acid. According to the resistance in the circuit, and the consequent current density at the electrodes, a high or low polarization can occur in the HNO_3. For example, with two platinized electrodes in concentrated HNO_3 direct current readings of 210 and 450 could be obtained in either direction, the lower reading being given when the external resistance on closing the circuit was small, the higher when the current density at closing was low and was gradually brought to full value. The higher reading could also be obtained if the circuit were broken and immediately restored, or by the introduction and removal of resistance. The rise from the lower to the higher value was quite rapid when once started. It seemed as if an unstable equilibrium were formed which could be thrown into stable equilibrium in the manner described. Denoting a smooth platinum electrode by S and a platinized by P the following were typical direct current readings for the cells tried, the impressed e. m. f. being about 3.3 volts:

Cell.	Current.	
S — HNO_3 — H_2SO_4 — S	180	100
P — HNO_3 — H_2SO_4 — S	80 and 210	100
S — HNO_3 — H_2SO_4 — P	325	115
P — HNO_3 — H_2SO_4 — P	185 and 340	135

The main flow of current in all cases being toward the HNO_3 any sulphate solution may be used in the place of H_2SO_4, without interfering with the action by covering the sulphate-electrode with a layer of active metal; certain advantages accrue from the use of solutions having a higher decomposition value than H_2SO_4. $ZnSO_4$, pure or with a little H_2SO_4 to improve its conductivity, in place of the H_2SO_4 gave almost the same effect as H_2SO_4.

Cells in which the irreversiblity is secured by the discharge of

*Proc. Lond. Phys. Soc., Vol. IX., 1888: or, *Phil. Mag.*, Vol. XXV., p. 276, and Vol. XXVI., p. 126.

†*Wied. Ann.*, Vol. XXXIII., p. 80, 1888; also, Vol. XXXVIII., p. 362, and Vol. XXXIX., p. 187.

‡*Zeit. fur Elektrochemie*, Vol. IV., p. 376, Feb. 20, 1898.

the gases from their electrodes, instead of by means of an irreversible oxidizing electrolyte, may be constructed. The two essential requisites of the liquids are that their decomposition values be different, and that they be of such composition that the "useful" current deposits a gas on both electrodes. A typical cell is Pt — $ZnSO_4$ — H_2SO_4 — Pt, the "useful" current flowing toward the H_2SO_4; with 2.2 volts impressed no asymmetrical effect was observed; with 3.3 volts, readings of 15 were obtained with the alternating current. Using smooth electrodes differing in size, or a platinized electrode in the H_2SO_4, changed the direct current readings, though affecting the alternating but slightly.

Cells can be formed in which the differences in counter e. m. f. are produced by the non-metallic ions, instead of by the metallic as in the foregoing cells. A typical cell consists of the combination Pt—H_2SO_4 — HI—Pt, the counter e. m. f. in one direction being produced by H in H_2SO_4 and I in HI, in the other by O in H_2SO_4 and H in HI. Curves taken on such cells show considerable asymmetrical efficiency.

It should be possible (though the writer has not attempted it) to construct cells having two inert electrodes in two electrolytes of such composition or concentration that the electrodes will polarize and no current flow except on the application of a properly directed, or an alternating e. m. f. It should also be possible to construct cells on the principle of oxidation and reduction cells which will have similar properties.

It may be remarked, in conclusion, that the actions in the foregoing rectifiers are undoubtedly due to the counter e. m. f. effects by which they have been explained. Resistance produced by gas bubbles is shown by the smoothness of the plotted curves to be negligible. Resistance produced by a dense film at the anode is not the cause, for Gee and Holden state that no such film is formed in HNO_3, and the formation of such a film in the H_2SO_4 would retard, not aid, the action which goes on, and it has been shown that dilute HNO_3 can be used to replace the H_2SO_4. Finally, the direct current produced is not due to the action of a liquid (concentration) cell, for in the cell Pt — Conc. HNO_3 — Dil. HNO_3 — Pt the alternating current drives the hydrogen toward the concentrated acid, while the natural tendency of the hydrogen (without the application of an external e. m. f.) is to go toward the dilute acid. In general the e. m. fs. due to the equalization of liquid concentrations are too evanescent to produce the long-continued effects observable in the curves plotted.

Cells having simply a large and a small plate in 25 per cent H_2SO_4 were tried. The current density was kept too low for resistance effects due to steam,* and the electrolyte used was probably too dilute for those investigated by Gee and Holden; it seems possible that the results were produced by differences in the polarizations at the small plate when used as anode or cathode. The current, as shown by a $CuSO_4$ voltameter with clean platinum electrodes, passes the more easily through the electrolyte toward the smaller plate, but for only a short time. Curves taken with the large plate stationary showed practically no asymmetrical effect. By rotating the large plate (a 1 cm. x 10 cms. strip of platinum wound about a cork) an efficiency of about 6 per cent. was obtained. A small platinum and a large platinized plate in dilute H_2SO_4 permitted a small direct current to pass more easily in one direction than in the opposite, but no effect could be noted with the alternating current.

Automobiles in War.

The British-Boer war in the South African Republics has had the effect of promoting the prosperity of the automobile vehicle manufacturers. Commenting on this subject the London *Court Journal* says that six months ago the motor car as applied for business purposes was not being very generally adopted, but since the outbreak of hostilities in South Africa the streets have become comparatively thronged with "auto-vans." The reason is the tremendous demand for horses for the troops at the front. The horses of the omnibus companies, which have been commandeered by the government, have had to be replaced. The motor vehicles are supplying the want, and it is satisfactory to know that they have been found much more economical.

*"Wehnelt Interrupter Effect," Eichberg and Kallir, *Zeit. fur Elek.*, April 16, 1899; *L'Elec.*, June 10, 1899. Also Mengarini, Lond. *Elec.*, Vol. XXVII., pp. 304 and 334; *Elec. World*, Vol. XVIII., Aug. 8, 15 and 22, 1891.

Large Central Station for Denver, Col.

By J. W. Dickerson.

By the passage of an ordinance on March 30 the Denver Board of Supervisors ensured the erection of a large and modern electric light station capable of supplying the entire city with current for arc and incandescent lamps for municipal, residence and commercial purposes. The franchise was granted to C. F. Lacombe, who is president of the Mountain Electric Company, of Denver, and interested in electric enterprises throughout Colorado. The award of the franchise was the result of an agitation for municipal ownership of electric lighting. The administration now in control of the city government was pledged to favor ownership by the city of all electric lighting. In order to carry out its obligation the administration decided to give a franchise for an electric light plant in which the city would gradually acquire an equity and finally obtain full ownership, for under the provisions of the city charter bonds cannot be issued for building an electric light plant.

There are required in Denver at the present time for municipal lighting 1000 arc lights, and the annual increase is estimated at 50 lamps, at an additional cost of $75 per lamp. To supply 2500 users of incandescent lamps, averaging 20 kilowatt hours per month, 50,000 kilowatt hours capacity will be needed in the new station. The 75 consumers of electric power, averaging 500 kilowatt hours per month each will demand 37,500 kilowatt hours output in the station. For commercial purposes 225 arc lights must be provided from 6 p. m. to 12 p. m.

The following figures relating to the probable cost of a municipal and commercial lighting plant to carry the load for the purposes just mentioned are taken from the report of Eugene Y. Sayer, city electrician of Denver, and are full of interest:

The original cost of a plant for municipal arc lighting is figured at $275,000, and that of a complete plant for commercial lighting is found to be $400,000. The original cost of the arc circuits was estimated as $120,000. The items of depreciation were figured as follows: On arc plant, including power house, machinery and circuits, 4 per cent. per annum; depreciation of outside circuits, 5 per cent. per annum; depreciation of power house and machinery, 3 per cent., and the life of the plant is considered to be 20 years.

Four bidders submitted figures for furnishing a plant which the city, upon a given payment, should acquire at the expiration of a certain term of years; they made bids on both a municipal arc plant only and a combined municipal and commercial plant. These figures, which are more than ordinarily instructive and interesting, may be summarized as follows:

Bennett & Myers; cost to city for arc lights, per year, $75,000; cost to city and private consumers per year for all electric lighting and power, $192,570; municipal arc lighting plant may be purchased by the city for the original cost at the expiration of any five years.

The Seckner Contracting Company; cost to the city for arc lighting per year, $100,000; cost to the city and private consumers for all electric lighting and power per year, $184,003.75; the city may purchase the municipal arc lighting plant at the end of 10 years on the payment of $1,000; the plant for commercial lighting may be bought at the end of 10, 15 or 20 years at a price fixed by an arbitrating committee.

Charles F. Lacombe and assigns; cost to the city for arc lights per year, $95,000; cost to the city and private consumers per year for all electric lighting and power, $196,850; the city may purchase the plant for municipal arc lighting at the expiration of 10 years by the payment of $40,000. The plant for commercial lighting may be bought at the end of 10, 15 or 20 years at a price fixed by an arbitrating committee.

The Denver City Light & Power Company; cost to the city per year for arc light, $62,500; cost to the city and private customers for all electric lighting and power, $143,378.75; the city may purchase the outside circuits at the end of 5, 10, 15 or 20 years at the original cost less 5 per cent. of the original cost for each year after the completion of the lines, and in that case current will be furnished by the company at $30 per lamp per year.

The first bidder named agreed to complete the plant in 12 months, the second and third in 11 months and the fourth in 14 months.

The ordinance provides that all the arc lights, used for city

lighting, now in service and furnished by the Denver Consolidated Gas & Electric Company, shall be duplicated in number and location. There seems to be no doubt that the commercial plant will be constructed, as well as that for municipal lighting. The bond of the successful bidder covers that point fully. He agrees in addition to deposit with the mayor a certified check for $25,000 to be forfeited as liquidated damages in case he does not, in the time provided, cover substantially the territory included in the limits of the city of Denver, and now covered by the present electric lighting system. Before the franchise came to a vote Mr. Lacombe made an agreement to charge $90 per year for arc lights instead of $95, and to charge $70 for all lamps in excess of 1,000. In his statement to the mayor supplementing his original proposition Mr. Lacombe gave a definition of the word "plant" that it might not be ambiguous. His definition may be useful. It is as follows: "The word 'plant' has a fixed meaning. It includes real estate, buildings, fixtures, machinery (steam and electrical), poles and wires, connections and lamps complete, in place, and instruments and appliances necessary for the economical and successful operation of the system, and all property of whatever kind or nature used in supplying said street lights."

Mr. Lacombe says that every effort will be directed toward rapidly building the plant, both municipal and commercial. While the ordinance provides that the plant shall be ready in 11 months Mr. Lacombe does not propose to avail himself of that limit if he can avoid it. The ink was hardly dry on the mayor's signature approving the ordinance before telegrams had been sent ordering machinery and supplies. Within half a year the company to be incorporated will, if possible, have the entire plant in running order and will expend in doing so three-quarters of a million dollars. It will be a modern and thoroughly up-to-date plant in every particular.

According to the franchise open arc lamps of 450 watts and 2000 nominal candle power are to be used; but City Electrician Sayer is anxious that instead a 500-watt enclosed arc light should be employed, as he believes the light of the latter would be more mellow, more powerful and satisfactory in every way. A few nights ago Mr. Sayer made a test of the two styles of lamps, the pair being placed within 20 feet of each other so that a good comparison could be made. Mayor Johnson, who watched the experiment with interest, decided at once in favor of the enclosed lamp, and his opinion was endorsed by all who watched the test. It is estimated that the increase of the wattage of the lamps from 450 to 500 will cause an added expense of $10,000 in the coal bills. This increase in operation will be, it is believed, more than counterbalanced by the saving in labor for trimming carbons and in the cost of carbons. According to the figures of City Electrician Sayer, the cost of domestic carbons for an open arc lamp burning 14 hours a day, amounts to about $8.80 per annum, while high grade carbons for the enclosed arc lamp under the same conditions cost only $1.37 for the same time, a saving of $7.43. The enclosed lamp will burn without trimming 150 hours, or 10 days. An employee who could trim a given number of lamps in a day could trim eight times as many enclosed arc lamps as open arc lights, as he would have to attend to the enclosed lamps only once in eight or ten days. Then, too, Mr. Sayer favors this light because it radiates a greater volume of light. In all probability the enclosed arc lamp, which possesses so many advantages over the open arc, will be generally used in the new system.

The land for the new station has not yet been secured, but in all probability it will be leased from the city and will be located on the river bottoms, near the railroad tracks, where coal can be hauled from the mines direct to the station, and where water will be obtained for condensing purposes.

The company to be incorporated to take over the franchise granted to Mr. Lacombe will be known as the Lacombe Electric Company. The following are the incorporators and directors for the first year: Charles F. Lacombe, Harry J. O'Bryan, Z. T. Hill, M. L. Stern, William S. Bagot. Among those, in addition, interested in the company are Cass E. Herrington, Fred Dorr, E. H. Lacombe, of New York; P. V. Carlin, George L. Broom, J. W. O'Connor, John D. Farrish, also William A. Otis, H. C. Hall and L. E. Curtis, of Colorado Springs, Colo., and the officers of the Western Electric Company, of Colorado.

The capital stock of the Lacombe Electric Company will be one million dollars.

Heavy Damage from Snow Storm in Colorado.

THE heavy snowstorm of April 5, in the opinion of superintendents, occasioned greater damage to the overhead construction of the electrical companies in Colorado than ever was sustained from a similar cause in the history of these corporations. According to a conservative estimate, perhaps it should be said a conservative guess, the loss from the destruction of property, in the entire state, to not less than $200,000. In Denver alone, the damage was said to aggregate $75,000, of which the telephone company had to stand $20,000. In Colorado Springs the telephone loss was not less than from $8,000 to $10,000, and the electric light and street railway companies, in this city and in Manitou, also will be obliged to charge up a considerable amount for the expenses incidental to the storm.

The storm raged all the afternoon and evening of the 5th inst. and the early morning the the 6th, and it was only as the result of the most heroic efforts on the part of the Denver Tramway Company's employees, under the direction of Superintendent Durbin, that the lines in that city were kept open. The fall of wet, heavy snow ceased at 3 a. m. on April 6, and every effort was made, and, fortunately, with success, to accommodate the early patrons of the motor cars. It was necessary to straighten out a complicated mix-up of all kinds. For example, a pole had fallen at one of the main business corners and severed the wires and cables passing at that point as effectually as if the job had been done with a pair of nippers, and the tramway current raised mischief with the dangling circuits.

The linemen worked with great bravery in the midst of ever-present danger from a network of wires. After a long and tedious period of labor all but the small wires were disentangled, and the order was given to turn on the full volume of current and burn them off. A brilliant pyrotechnic display followed, but the wires were cleared.

The Denver Tramway Company certainly made a great record under these severe conditions. Its lines were kept open, and except in ths suburbs, schedule time was maintained during the time of the storm's duration.

The Denver Gas & Electric Light Company suffered comparatively little, and would have been troubled even less had not wires from its neighbors fallen across its circuits.

The telegraph companies were troubled very little, much less than might have been expected. Practically no communication was suspended during the storm.

The telephone company suffered from the interruption to its long-distance service very seriously. On Thursday morning only two of sixteen wires were working between Denver and Colorado Springs, and the Pueblo service was also crippled. Only one of the seven wires between Denver and Leadville was to be depended upon.

A great deal of inconvenience and not a little danger was occasioned by breaks in the wires, and a number of small fires were caused. The fire alarm system was almost wholly put out of service and for two days the city ran the risk of a conflagration without the means of instant communication with the department. The county jail on Thursday had no telephonic communication with the court house, so that had the sheriff had trouble with his prisoners the result might have been serious. The police telephone system was also almost entirely useless.

At Colorado Spring street car traffic was almost at a standstill for two days; in fact, transportation of any kind was almost out of the question. The electric light and telephone companies suffered seriously from breaking of poles and the interruption of service. Manager R. F. Morris, of the Colorado Telephone Company, at the Springs, reported that his service had been badly demoralized. In and near Manitou there was not a pole standing for the distance of a mile, and burn-outs because of crossed wires were without number. On Thursday morning no communication to points in the long-distance system was possible. Ordinarily there is the greatest demand for conversation with Cripple Creek; twelve wires are in regular operation, and an increase in the equipment is urgently needed at the present time, for a large proportion of the mining properties is owned, controlled and dealt in at the Springs. The morning after the storm not a single circuit was in operation to the famous mining camp. Manager Morris made the most herculean efforts to secure the opening of these important circuits. By 10 o'clock on Thursday he had one line in fair working order. For the purposes of repair he was fortunate in having a man stationed at the half-way point, up

Pike's Peak, which all will remember who have made the trip on the famous Cog Road. The line was down in places, but under the circumstances the service was more than fair. By the same hour on Thursday he had two circuits working to Pueblo, and service to Denver was resumed early in the day.

At Cripple Creek the District Electric Railway was forced to suspend operations from Wednesday morning to Saturday night. It was almost impossible to carry on traffic with Victor. Many miners accustomed to ride in the electric cars were obliged either to walk through the deep heavy snow to their work or to remain at home. Most of them chose the latter alternative. A force of 125 men was put to work on the tracks, as the snow was packed so hard that plows were ineffective. The telegraph service was in fair shape, but telephone communication was cut off, as already noted.

Pueblo suffered far less than the other cities mentioned, as there the precipitation for the most part took the form of rain. The greatest inconvenience was the result of interruption of the telephone service.

Modern Central Station Practice.

At the April meeting of the Electrical Section of the Franklin Institute Mr. Charles F. Scott presented a paper on "Modern Central Station Practice." Mr. Scott pointed out that the word "modern" in this connection must refer to the last four or five years, as the "ancient" in central stations dates back only a score of years. The bitter controversy between alternating current and direct current which prevailed ten or twelve years ago, has been renewed in another form. The direct current has had a fairly well defined field in the centres of cities, while the alternating current has not only found favor in towns and out'ying districts where areas are wide, but has also been used extensively for distribution as well.

In the new engineering which is made necessary by the extension and combination of electric interests, it is essential to generate power in large stations favorably located. Direct-current distribution therefore demands an alternating current power station distributing to sub-stations, where the current is converted into direct current by rotary converters. The question then arises whether it is better to convert into direct current or to distribute the alternating current without the intervening machinery with its inherent losses and the complication in operation which are involved if the current is converted into direct current. The various pieces of apparatus, including generators, rotary converters and motors, which are used in connection with the central station systems were then taken up in detail. The most recent types of construction were illustrated and explained, and particular attention was given to those characteristics which are of particular engineering interest, and which bear particularly upon the choice between direct current and alternating current distribution.

In connection with the parallel operation of alternators a mechanical analogue was presented in the form of two engines which drive a common load through gear wheels which are connected with pinions on a common shaft, instead of alternators which are connected to common bus bars. It was pointed out that the operation of the engines, both as to the manner in which they may be first connected together, the conditions relative to division of load and to the shifting of load between the two engines, are the same in most respects whether the engines be connected by gear wheels or alternators.

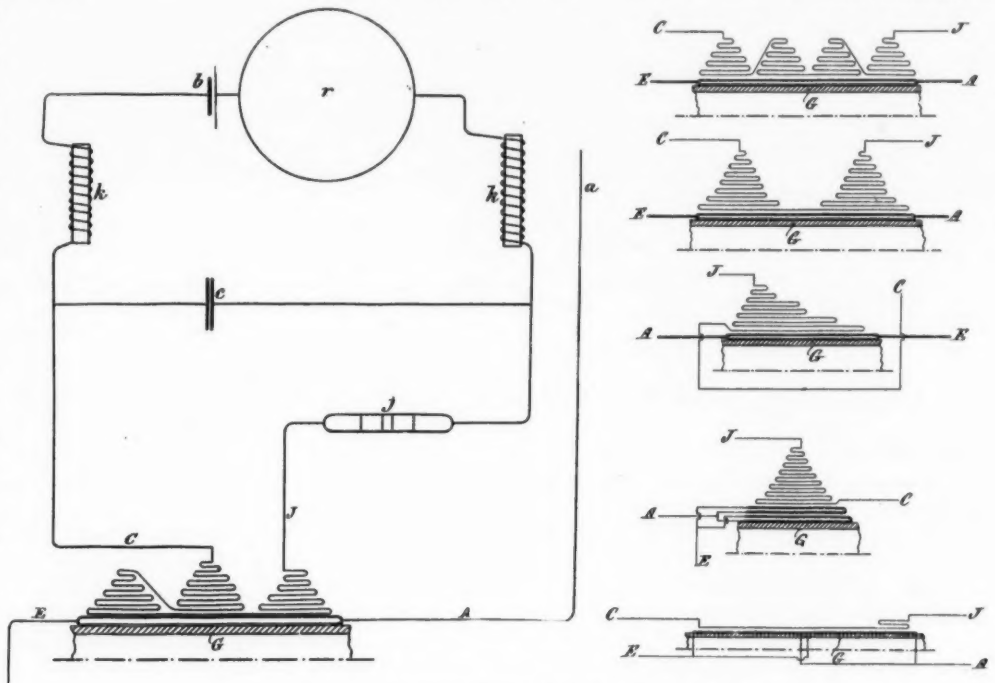
Some interesting facts respecting the operation of rotaries, particularly as to "hunting," were presented, together with the means which are effective in counteracting the various tendencies to this action. It was stated that the better class of rotaries are now operating with the same high standard of excellence which characterized other types of electrical apparatus.

The old controversy between the induction and the synchronous motor is rapidly dying out as there are few, if any, who advocate the synchronous motor for small work, while the dividing line in size between the field where induction motors are universally accepted and that in which there is still some difference of opinion is rising. Mr. Scott stated that he thought it quite certain that the induction motor would not wholly replace the synchronous motor, as there are some few conditions under which some of its features are of sufficient value to more than compensate for its many objectionable elements. The adaptability of the induction motor to general service of a city where simplicity and reliability are of paramount importance was explained and it was pointed out that while reliability rather than efficiency is the important element, yet the efficiency of the induction motor is practically the same as that of the direct-current motors at full load, it is higher at small loads, particularly in small sizes, where the brush friction of direct-current motors is comparatively high.

The characteristics of alternating current apparatus make it in many respects the ideal form for use throughout the whole of a city plant. The difficulty which confronts the engineer at the present moment is the necessity of using the various existing apparatus in a comprehensive system, while at the same time he may be working forward to ultimately reach the system which will possess the greatest simplicity, reliability and economy in its operation.

New Marconi Patents.

Three patents were granted, April 10, to Marconi, all of which relate to forms of the induction coil or transformer of which one side is in the aerial conductor circuit and the other side in the coherer circuit. Referring to Fig. 1, which represents the usual Marconi wireless telegraph circuit, *a* is aerial conductor, *b* the local battery, *c* a condenser, *e* a connection to earth or other suitable capacity, *j* a coherer, *k* choking coils and *r* a relay for working and signaling on other instruments. In place of winding both primary and secondary of the induction coil in single layers, it is now made either very short or else wound in two or more sections as shown in the accompanying illustrations, and the number of turns in the layers diminished as the distance from the centre increases. It is also found desirable to connect direct to the coherer the end of the secondary, *j*, which is farthest away from the axial line of the coil. In Fig. 1, *A* is the end of the primary which is connected with the aerial conductor *a*, and *E* is connected to earth or a capacity. *G* is a glass tube on which the coils are wound. The wires are preferably insulated by a single covering of silk.



FIGS. 1 AND 2.—ILLUSTRATING NEW MARCONI PATENTS.

A number of different methods of winding are described and shown in the accompanying Fig. 2. The data of the coil of Fig. 1 are as follows: Diameter of the glass tube, *G*, .935 cm.; diameter of both primary and secondary, .01 cm. The primary has two layers of 160 turns each, in parallel. The secondary consists of three

sections with 10, 12 and 10 layers respectively; one layer of 150 turns is common to the three sections, and the latter taper from 45, 40 and 45 turns to 5, 5 and 14 turns on the outer layer. The length of the coil is 2.5 cm.

Power House for the Manhattan Elevated.

The Manhattan Elevated Railway Company, on April 16, filed at the Building Department plans for the power house which is to supply the electric power for the operation of the road. The station will be a huge three-story structure of brick and stone, located upon an irregular plot bounded by Exterior Street, Avenue A and Seventy-fourth and Seventy-fifth Streets. It will cost $750,000.

Rapid Transit Contracts.

The Rapid Transit Subway Construction Company on April 16 awarded three contracts for materials and eight for construction. The Carnegie Steel Company will furnish the necessary 72,955 tons of structural steel and iron for the whole road; the Sicilian Asphalt Paving Company will do the 775,795 square yards of asphalt waterproofing, and the United Building Material Company will furnish the Portland and other cement. The successful bidders, so far, for the actual work of constructing the tunnel, stations and passenger elevators and for doing the preliminary work in their respective sections are as follows: The Degnen-McLean Construction Company, Section 1, the Post Office loop to Chambers Street, and Section 2, from Chambers Street to Great Jones Street, on Elm; E. J. Farrell, Section 7, from portal of tunnel at 103d Street to 110th Street and Lenox Avenue, and Section 8, from 110th Street to 109 feet beyond 135th Street along Lenox Avenue; John C. Rodgers, Section 9, from 100 feet north of 135th Street on Lenox Avenue under Harlem River and then east to Brook Avenue; John Shields, Section 11, from 104th Street on the west side line to 10 feet beyond 125th Street; L. B. McCabe, Section 13, from 133d Street to 100 feet beyond 181st Street, and Section 14, from 181st Street to Hillside Avenue. The amounts of five of the eight bids accepted are approximately as follows: Post Office loop, $1,250,000; Section E, from Chambers to Great Jones, $2,000,000; sections 7 and 8 together, approximately $1,600,000. The successful bid for Section 9, including the Harlem River tunnel, was a little below $2,000,000. The total length of tunneling and excavation called for is 7500 feet.

CURRENT NEWS AND NOTES.

FRANKLIN INSTITUTE.—At the meeting of the Electrical Section of the Franklin Institute, Philadelphia, last Tuesday evening, Mr. J. Franklin Stephens read a paper on "Electrical Instruments."

MORE CONDUIT RAILWAY IN NEW YORK.—The work of changing the motive power on the Lexington Avenue line from cable to electricity was begun on April 16, and will probably be completed in two months. The company is doing the work itself and has 500 men on the job.

LONDON COMMERCIAL EXHIBITION.—A commercial exhibition of American manufactures in London is under consideration by Pitt & Scott, the well-known foreign freight brokers and express carriers of 39 Broadway, New York. Circulars relating to the same may be obtained upon application.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—A special rate of railroad fare has been granted by all the passenger associations—being a fare and one-third for the round trip—for delegates attending the twenty-third convention of the National Electric Light Association, to be held at Chicago, Ill., May 22, 23 and 24.

FRENCH PATENT OFFICE PROCEDURE.—A bill has been introduced by the French government into the Chamber of Deputies, allowing three months' grace in the payment of taxes on patents; a fine of 30 francs will be imposed for delinquencies extending into this period. The patent office has also decided to experimentally print the 1899 patent specifications and drawings separately, instead of having them form a volume as formerly.

SOCIETE INTERNATIONALE DES ELECTRICIENS.—At the April meeting in Paris of the Société Internationale des Electriciens, the following officers were elected for the term 1901-2: President, M. Hillairet; vice-presidents, MM. Bochet and Leblanc; secretaries, MM. Armagnat and Larin; treasurer, M. Violet. At this meeting M. Mascart was inaugurated president for the term 1900-1. M. Villard read a paper on cathode and Röntgen rays.

RAILROAD TELEGRAPHERS STRIKE.—The telegraph operators on the Southern Railway struck last week, and there is an irreconcilable difference between the statements made by both sides as to the effect on the railroad's operations. The president of the Order of Railway Telegraphers reports that 900 telegraphers have struck, and that the entire system of the Southern is tied up. On the other hand, the railroad officials are reported as saying that the strike is a thing of the past, and deny that the delay to any of their trains is due to it.

TELEGRAPH FACILITIES FOR THE KANSAS CITY CONVENTION.—It is reported that the Postal Telegraph Company will spend nearly $300,000 before July 4 in perfecting its facilities for the work of handling the national convention at Kansas City. Of this amount $284,938.10 will be expended in building new wires east and west from Kansas City and $14,000 for telegraph poles in Kansas City alone. National conventions are the severest tests of telegraph facilities. The number of words which the Western Union and Postal Telegraph companies are required to transmit to the newspapers alone average more than one million daily.

LAMP TESTING BUREAU.—Papers have been filed in Albany by J. W. Lieb, Jr., C. L. Edgar and W. S. Barstow, incorporating the "Lamp Testing Bureau," with a capital of $20,000. The Lamp Testing Bureau was originally organized by the executive committee of the Association of Edison Illuminating Companies for the purpose of testing incandescent lamps for the members of the association who are licensees of the General Electric Company. For the past three years this work has been in the hands of a special lamp committee of the association, but the increase of business of the bureau and the necessity of providing additional facilities have made it desirable to organize the bureau as a separate corporation.

ELECTRIC ELEVATOR.—A patent issued April 10 to F. J. Sprague describes an electrically-driven elevator mechanism in which there are two sets of positive driving gearing with separate electric motors connected to each set. The main element of novelty lies in the connection of the armatures of the two motors in series to the source of electrical supply, the fields being shunt wound. Motors with their armatures in series are difficult to maintain at equal speeds, since an inequality of field strength will cause the armature of the motor with the stronger field to respond more quickly and consume the greater part of the energy in the circuit, so that sufficient potential will not be left across the other armature to set it in motion. With, however, the motors positively geared to each other, they cannot thus become unbalanced.

ELECTRICAL COMMUNICATION IN THE PHILIPPINES.—General Greely, Chief Signal Officer, U. S. A., says that the Island of Luzon is now overspread with a network of telephone and telegraph lines, extending on the east from Manila northward to Aparri, at the mouth of the Cagayan River, and on the west from Bangui, at the northwest extremity of Luzon, down the coast line and back to Manila. Cables have been laid in the waters of Manila Bay from Manila to Cavite, and in Laguna de Bay from Taguig to Binan, and from Taguig to Calamba, to Los Banos, thence to St. Cruz, on the eastern shore of the bay. He states that over a million words are transmitted in the Philippines daily. The demand for operators still greatly exceeds the supply, and every man in the signal service who possesses electrical knowledge to any degree is at once despatched to Manila. Thus experiments in war ballooning, wireless telegraphy and other features of the service are for the time being neglected for lack of suitable men to conduct them. A new system of wireless telegraphy is being investigated at Governor's Island, New York, but work in that direction cannot be promoted with any rapidity until suitable men are provided.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS ABROAD.—The English Institution of Electrical Engineers will entertain the members of the American body who may be in London just previous to the joint meeting in France. Arrangements have been made for the American and English members to proceed to Paris from London by the same conveyance.

ELECTROLYZING APPARATUS.—A patent granted April 10 to MM. Chalandre, Colas and Gerard, of Paris, France, describes an electrolyzing apparatus having for an object obtaining soda on the one hand, and pure chlorine on the other hand in maximum quantities. A portion of the gas liberated at the anode is combined with hydrogen liberated at the cathode to form hydrochloric acid into an anode compartment provided with a porous diaphragm in order to counteract the secondary reactions arising from chlorine gas compounds which form in the electrolyzer. The hydrochloric acid is formed in quantity just sufficient to effect this purpose, so as to avoid any accumulation of the acid in the apparatus and the consequent tying up or loss of a portion of the chlorine.

MOTOR-STARTING RHEOSTAT.—In a patent granted April 10 to Elihu Thomson, a motor-starting rheostat is described having for its object to provide an arrangement by which a motor will not at any time have an undue supply of current. The handle is connected to the switch arm by a mechanical clutch controlled and actuated by a coil arranged in the main circuit. If at any time the current exceeds a given value, the connection between the handle and switch is released, allowing the former to turn freely and holding the switch until the counter e. m. f. rises sufficiently to reduce the flow of current. To provide for control when the clutch is released, a pawl on one part of the clutch and a ratchet on the other part are so arranged that the switch may be turned backward at will.

TRANSMISSION OF ELECTRICAL IMPULSES.—In the art of telegraphy it has heretofore been common to transmit positive and negative impulses so combined as to afford a means of communication in conformity with a prescribed code. It has also been proposed to transmit a series of alternating current impulses of a uniform frequency and to interrupt the alternating current thus introduced at the zero points in accordance with a prearranged code. In a patent issued April 10 to Dr. Fredk. Bedell, it is stated that in neither of these two methods has it been attempted to modify the wave form to meet particular circuit conditions, while in the second method the interruption unfavorably occurs at the moment of greatest induction. As an improvement the patent describes a method whereby, employing a direct current, a given wave form is produced by a rheostat in circuit, the arm of which at the sending end travels synchronously with a receiving arrangement at the other end. By this means any desired form of wave may be produced, and an apparatus is provided whereby the normal wave length may be multiplied by two, three or any desirable number.

STORAGE BATTERIES.—Three patents were issued April 10 on storage batteries—one to P. G. Salom, another to C. J. Coleman and a third to H. S. Gladstone, of London, England. The Salom patent relates to a plate occupying a position between an ordinary Planté plate of solid lead and a pasted plate. A mass of spongy lead is subjected to such pressure in a suitable mold that the particles will be caused to cohere. When a plate of this character is charged, it can be much more readily oxidized than a solid lead plate owing to its lesser density; and as the plate consists of a coherent homogeneous mass, it is not as liable to disintegration as a pasted plate. Moreover, owing to the low cost of spongy lead as compared with solid cast lead, the lead oxide and plate can be made more cheaply than either of the other usual forms. The Coleman patent describes electrodes consisting of a tubular perforated casing containing active material, provided with a flattened upper end or neck for connection to the conducting strip or bar. The latter is an inverted U-shape and receives the necks of the casings between its vertical members. The Gladstone patent describes an electrode consisting of a flattened envelope of perforated sheet material containing within it a mass of active material and a central core of perforated sheet having end lugs of lead. A number of these electrodes may be united to form a single electrode by connecting bars, forming a grid-like structure. The adjacent positive negative elements are held apart by means of diaphragms formed of corrugated sheets of perforated vulcanite or other suitable insulating material.

Letters to the Editors.

The Mechanical Congress at the Paris Exposition.

To the Editors of Electrical World and Engineer:

Sirs:—M. Marcel Delmas, 10 Boulevard Emile Augier, Paris-Passy, has charge of the report of the "Congres de Mecanique de l'Exposition Universelle," in the department of applications of electricity to the various apparatus of haulage, hoisting, etc. (including cranes, elevators, winches, swing bridges, pumps and other such mechanisms), and particularly desires information regarding the economic side of the matter. He requests that all, whether intending exhibitors or others, who are willing to assist in the collection of this data, send him, at the address given above, statements of costs of installations, of exploitation and incidental expenses; especially where a comparison can be made with costs of the older systems under similar circumstances. All publications and illustrations will be welcome, if authentic and exact in statements of facts and data.

Ithaca, N. Y. R. H. Thurston.

Commutatorless Dynamos.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to Mr. Griene's letter in your issue of April 14, I beg to say that the machine there described is evidently inoperative. The pole-pieces revolve in opposite directions, and as the magnetic flux cannot be expected to revolve in two directions at once, it will remain stationary. This would result in no cutting of lines of force.

Philadelphia, Pa. P. C. Percy.

A. I. E. E. Council Nominations.

To the Editors of Electrical World and Engineer:

Sirs:—While we are in favor of the election of Dr. Pupin for president of the American Institute of Electrical Engineers we greatly regret the form of the circular headed "Dr. Pupin for President," which has lately been circulated among the members of the Institute and especially that portion of the circular found in Section 4, in which we are made to confirm certain statements as to the possible nomination of the council, in case a full meeting of that body had been held at that time for the selection of the "council nominees," and because of the unfriendly attitude toward Mr. Carl Hering, which the circular appears to take.

Such portion of the above circular which appears to criticise the action of the Institute and the selection of Mr. Carl Hering for "council nominee," we entirely disapprove of, and when asked if we would favor the election of Dr. Pupin for an independent candidate we had no idea that any action would be taken to criticise the Institute and reflect upon Mr. Carl Hering.

William Stanley.

New York. F. A. C. Perrine.

To the Editors of Electrical World and Engineer:

Sirs:—A few days ago I received what appeared to me to be the official list of "Council Nominees" for officers of the American Institute of Electrical Engineers. As there was no evidence of any irregularity, I immediately detached this list from the "General Proposal List," inclosed it in the voting envelope and mailed it to the secretary, as has been my custom in the past.

The next day I was surprised to receive an *unofficial* circular letter, purporting to be signed by a majority of the Council, repudiating the "Council Nominees" list in one particular, and intimating that one nomination was made in some way without the sanction of the Council, though it was, as usual, the name of the person receiving the highest number of nominating ballots for that office. The circular also, while it *urges* us to vote the official ticket with that one exception, contains the following remarkable statement, "We are, however, firmly convinced that the nominations sent in this year do not represent the opinions of the members."

I have no personal interest in the question at issue, and would cordially support either the gentleman named officially or the gentleman

named unofficially by the Council, but should like to be enlightened as to whether in the future we can rely on the nominations sent out by the secretary, as being the Council nominees, or whether we are to suppose that a majority of the Council are in the position of the man who stayed away from the polls on election day and then claimed the election was illegal because he had not voted?

The only really serious question in this proceeding seems to me to be the manner in which a member's name may be put forth officially by the Council as a nominee without his knowledge, and afterwards dropped *unofficially* by the Council in a manner implying that his nomination had been secured through fraud. C. J. REED.

PHILADELPHIA, PA.

To the Editors of Electrical World and Engineer:

SIRS:—I notice with regret the circular sent out simultaneously with the official nomination sheet of the Institute.

As one of the active members and managers of the Institute in its early days, I am naturally sorry to see any steps taken which might be interpreted as indicating the growth, now, of factionalism.

The issuance by absentee members of any parliamentary body of any printed matter in opposition to its regular action taken at a stated meeting held annually for the stated purpose, is certainly out of place, and other members at large of an association who join any of the governing members in such opposition with knowledge of the duty of the members and of the methods prescribed for ascertaining the judgment of the body, become participants in the same grave error.

Under such circumstances the members who gave up their time and did their duty, would be justified in declining to serve further, and such a course might also in future deter the best men from running the risk involved in accepting the Institute's nomination.

From my knowledge of many of the members whose names appear on the circular, I am very confident that its purport and its effect were not understood by them, and I am satisfied that when their attention has been called to it, there will be a number who will take pains to express themselves differently.

If any remedy is desired for existing or supposed evils or the ill-advised choice of any members or associates, surely the time and place for the members of the council to express their will in the matter is at the council meeting and not afterward publicly, to the discredit of that governing body of which they are members. And if they believe their view is the true one, they are false to their trust if they neglect to attend the meeting and vote.

It is to be hoped that the friends of the independent candidate, and I am one of them, will conclude to secure for him the recognition to which his attainments undoubtedly entitle him in another year, as originally planned, and not now seek to change the results of his having supported a third candidate until after the official nomination, as that would be at the cost of discrediting the council, who had as a guide an unusually strong nominating vote.

NEW YORK, N. Y. SCHUYLER S. WHEELER.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCE.

Two-Phase Motors.—Diagrams, with descriptions, showing the necessary connections for reversing the direction of rotation of a two-phase motor, and for the resistances for the same.—Lond. *Elec. Eng.*, March 23.

LIGHTS AND LIGHTING.

Automatic Lamp Interrupter.—A brief description of an incandescent lamp with an automatic interrupter, of the Schuckert Co. The socket of the lamp contains a small electrolytic cell in the form of a cartridge; the anode has a special form, and is dissolved by the current until after a certain number of ampere hours have passed, when it no longer makes contact with the electrolyte, and the current is broken. The same device may also be used as an automatic circuit breaker for other electric apparatus, where prepayment is required or where the placing of meters would be too expensive. The device is said to be cheap and sufficiently exact and it is easy to replace an old cartridge by a new one.—*Elek. Anz.*, March 1.

REFERENCE.

Air Pump.—A long well illustrated description of the Berrenberg air pump for incandescent lamp manufacture.—*Elek. Zeit.*, March 15.

POWER.

Gas Engines for Electric Stations.—MEYER.—An article on large gas engines, giving a table of comparative results of steam and gas power in generating electrical energy. The gas engines are driven by producer gas. For six German and Swiss gas plants the total average cost of fuel throughout the year per kw-hour is 1.4, 0.92, 0.6, 0.76, 0.72, 0.72 cents respectively; for three German steam plants 1.3, 1.32, 1.42 cents respectively. Other instances are given of steam plants with much larger power units, the total cost of fuel being lowest at Duesseldorf, where it is a trifle over 0.5 cent per kw-hour. It is often thought that the thermal efficiency of a gas engine is greatly diminished when the speed is lowered to any extent below the normal; this does not appear, however, to be borne out in practice. He says that the transformation of the energy of the gas into work in the cylinder of a gas engine is quite as certain, and almost as efficient, at a low speed as at the speed usually adopted, and that the adaptation of the gas engine for the direct driving of machines such as blowers, which are regulated by increasing or reducing the speed of rotation, is only a question of overcoming difficulties connected with the governing arrangements, and with the proper adjustment of weight in the flywheel.—Lond. *Elec. Rev.*, March 30.

Gas Versus Steam Plants.—A reprint of two reports on making the extensions of the King's Lynn electric plant for steam, the original machinery, on the advice of Prof. Robinson, and started last autumn, being driven by power gas. The report adopted by the council in which the change to motive power was advocated, has called forth a counter report from Prof. Robinson, which is reprinted. This has again been answered by Pilling, the electrician of the council, which is also reprinted. The points which are stated and disputed are that a gas system requires an excessive capital outlay which increases nearly in proportion to the size of the plant, while in a steam station this is not so; that as the plant increases in size, the economy in fuel consumption with gas plant vanishes; that the maintenance, repairs and attendance of a gas plant are greater than that of a steam plant; the noise and vibration were also referred to. The final decision of the council was in favor of steam.—Lond. *Elec. Eng.*, March 23.

Gas Engines for Electric Stations.—ADAMS.—An article in which he shows that, considering the best obtainable results for each class of apparatus, the steam plant consumes 66 per cent. more fuel than the gas equipment. Not only the amount of coal, but also its quality and price, are reduced by the adoption of gas producers and engines. The gas receiver renders storage batteries unnecessary, except for pressure regulation, and thus greatly reduces the cost of battery plant and the energy lost in its double transformations.—*Eng. Mag.*, April.

Gas Versus Steam Engines.—An editorial pointing out that a number of British plants were originally installed with gas power, while the extensions were reversions to ordinary steam practice. The controversy about the King's Lynn extensions (see abstract above) is also discussed in a special article.—Lond. *Elec. Rev.*, March 30.

Gas and Electricity.—ADAMS.—A comparison of the merits of gas and electricity for heating, lighting and power. He reaches the following conclusions: The great bulk of heat derived from public supply should be effected by gas. Power in small units is best distributed electrically, but for large units gas is more suitable. For purposes of illumination electric energy is much superior to gas from every point of view, and may be expected to generally supersede it for that purpose.—*Cassier's Mag.*, April.

Electric Motors in Workshops.—GIBBINGS.—A paper read before the Northern Society of Elec. Eng. in Manchester. The first gives a list showing the extent to which the electric motor has been adopted in various parts of Great Britain. It is not used there to the same extent as in America and Continental Europe; he thinks the principal reason is the better system of technical education in other countries than in Great Britain. A second table shows the increase in the number of motors supplied with current from the Bradford municipal station from 1891 to 1899; it appears that the system of letting out motors on hire is the chief factor which accounts for the highly satisfactory results. A third table shows the comparative cost of working electric motors as compared with gas, steam and water power; it is greatly in favor of electric power.—Lond. *Elec. Rev.* and *Elec. Eng.*, March 30.

REFERENCES.

Steam and Gas Engines for Electrical Supply.—An editorial note criticising unfavorably the article of Adams, noticed in the Digest March 24.—Lond. *Elec.*, March 23.

Electrically Driven Rotary Oil Pump.—A brief illustrated description of one brought out recently by a British firm, and specially designed for pumping heavy oils.—Lond. *Elec., Elec. Eng.*, March 23.

TRACTION.

Tramway Rail Tester.—A brief illustrated description of a simple apparatus devised by Lord Kelvin to test tramway rail bonds, when the rails are used for return currents. A graduated bar has attached to it two steel contacts for making contacts on the rails. They are provided with terminals and are connected by means of a flexible wire to the terminals of a low range voltmeter, which is contained in a light portable case, and shows directly the resistance of the rail bond or section of rail. Various degrees of sensibility can be obtained by altering the position of the contacts on the contact bar. No further description is given.—Lond. *Elec.*, March 30.

Three-Phase Power Distribution for Railways.—HARDING.—A brief illustrated description of the plant of the Union Railroad of Providence, R. I., which transmits power to a suburban line by three-phase current a distance of 18 miles at 9500 volts. At the central station there are two rotary converters of 300-kw each, operated by a direct current and generating two-phase current at 400 volts and 60 cycles; they are separately excited by a separate shunt-wound generator. The two-phase are changed to three-phase in the transformers, and at the substation the latter is again transformed to two-phase for use in the rotary converters, which supply direct current to the line.—*St. R'y Jour.*, April 7.

Grounds on Conduit Traction Systems.—An article describing how grounds are dealt with on such roads, like those in New York and Washington, on which both the positive and negative lines are insulated. Each conductor is divided into insulated sections of one-half to one mile in length, each having a separate feeder; double-pole switches on the switchboard enable the polarities of one of these feeders to be reversed. Ten lamps of 110 volts each, grounded in the middle of the series, are connected to the positive and negative conductors of each section and the ground is instantly shown by half of the lamps becoming bright; the switches are then momentarily opened to find on which line the ground exists; if a second ground occurs the connections are reversed, if necessary, to bring the ground to the same polarity until the grounds can be removed. Other similar methods are used to find whether the ground happens to be on a motor brush or armature, the successive sections being for this purpose alternately reverse in polarity; two grounded cars can be kept in operation on different lines by reversing the polarity of the different sections as those cars pass through them. A rheostat is used for burning out small grounds.—*St. R'y Jour.*, April 7.

Moving Platform.—An illustrated description of an ingenious method devised by Victor, for conveying passengers to the moving platform to be used at the Paris Exposition. It is difficult to describe briefly, but it is based on the following principle: The end of the moving platform makes a circular loop; inside this circle is a stationary circular platform with entrance from below at the centre: between this stationary platform and the moving one are horizontal circular discs which roll on the outside edge of the disc and on the inside edge of the platform; a passenger steps from the stationary platform on to this revolving disc, and steps off from it when it touches the moving platform; it will be seen therefore that where he steps on to and off from this disc there is no relative motion between the two parts, as the revolving disc rolls against both of them. Instead of a revolving disc which touches at two points only, a short revolving platform is used, giving the passenger more time to step from one to the other.—*Zeit. des Ver. Deut. Eisbu. Verw.*; abstracted with illustrations in *St. R'y Jour.*, April 7.

Southampton.—An illustrated article on the municipal electric railways of Southampton. The current is to be supplied by the lighting station. During the daylight hours it is intended to run pairs of the ordinary 230-volt lighting dynamos in series, in conjunction with a booster, on the tramway feeders, with the tramway battery across the 500-volt tramway circuit. Other machines, running at 230 volts, will take charge of the three-wire network for the ordinary supply. When darkness begins the demand for lighting current will be so large that all the dynamos in the station will be required for that service alone, so that during the peak of the load the tramway system will be run entirely on the large Tudor battery, the erection of which is being rapidly pushed forward.—Lond. *Elec.*, March 30.

Halle a. S.—A few notes stating that to avoid interference at the magnetic observatories of the University in this German city, the tramways have been compelled to operate all the cars in the neighborhood of the University by accumulators, and also to insulate the track from the earth as much as possible. The rails are laid in asphalt and the fishplates are made of hard rubber.—*St. R'y Jour.*, April 7.

Dayton.—A long illustrated article with a map showing the different lines in that city. The mileage of track within the city is 55 and the radiating lines vary from 25 to 94 miles in length; three of the latter are described. Two trolley wires are sometimes used over a single track to avoid overhead frogs. Several of the roads use telephones for despatching the cars, having a box every half-mile.—*St. R'y Jour.*, April 7.

Germany.—Some notes on electric traction in that country. In Munich there is a short stretch over which the overhead wires are forbidden, and in view of the fact that permission may later be granted to use them, the company now uses four accumulator locomotives to haul the cars over this short distance. In September, 1899, electric railways existed in 89 German cities against 68 in the previous year; the track mileage was 2048 as against 1429-km. The single accumulator system is used on only 7 roads; the number of roads using the mixed accumulator and trolley systems has increased slightly. Other statistics are also given.—*St. R'y Jour.*, Int. Ed., April; *Weekly News Edition*, March 31.

Tramways in Great Britain.—An editorial, an analysis of the accounts of four plants, and a colored map showing the towns in Great Britain having electric traction, the operating system being indicated and the municipal and company lines being distinguished. The preponderance of the trolley system is very pronounced. The four accounts refer to two trolley and two third rail lines, each one representative of a distinct type that can be made to pay well when worked electrically. The trolley system is considered the best, as it is the only system of mechanical traction for tramways that combines in a satisfactory degree the requirements of the public, the passengers, and the capitalists, whether ratepayer or shareholder.—Lond. *Elec.*, March 30.

American and British Transportation Methods.—HIGGINS.—An article discussing the difference between these methods, and pointing out the advantages of the American; diagrams and data are given, showing that the American methods are better; they also turn more money into the public treasury. The granting of long-time franchises to start companies he considers absolutely justified.—*St. R'y Jour.*, April 7.

Brooklyn.—RUSSEL.—A reprint of a short illustrated paper read before the New York Railroad Club. The five power stations of his company are described. On some long extensions on which the traffic is very heavy only in summer on pleasant Sundays, large feed wires were not installed, as they would not be used the greater part of the year; in those cases, when the load increases beyond a certain normal amount, a special booster is used consisting of a compound-wound generator with a resistance in the shunt field, which resistance is manipulated so as to raise the line voltage above that at the station to an amount depending on the load during the heavy traffic, when a drop of 40 to 50 per cent. is allowed on the feeders; in winter the same machine is used as an ordinary generator with the rheostat cut out. Some of the heavy trains from the elevated lines run on the surface tracks in the suburbs, and to prevent great fluctuations in voltage due to this heavy load, a storage battery is installed on freight cars which are moved every spring and fall to the most suitable place on that line for the corresponding half-year.—*St. R'y Jour.*, March 10.

REFERENCES.

Jungfrau Railway.—E. K. SCOTT.—A long well illustrated description of the Jungfrau three-phase electric railway, which has been referred to repeatedly in the Digest.—*Eng. Mag.*, April.

Perth.—A well illustrated description of the electric railway system in this city in Eastern Australia, which includes 20 cars and a temporary power station.—*St. R'y Jour.*, April 7.

Oshkosh & Neenah Railway.—A very well illustrated description of this interurban 16-mile trolley line, using three-phase current transmission and converter substation.—*Eng. News*, April 5.

Detroit.—A short illustrated description of this typical suburban line running to Lake Orian. The engine capacity is 650-hp, made up of two equal, direct-connected engines.—*St. R'y Jour.*, April 7.

Electric Traction.—WALTON.—An abstract of a lecture held before the Gloucestershire Engineering Society, in which he discussed the different systems of electric traction and spoke in favor of the trolley system.—Lond. *Elec. Eng.*, March 23.

Italy.—An article on the progress of electric traction on Italian railways. The lines described have already been noticed in the Digest.—Lond. *Elec.*, March 30.

Safety Fuses in Tram Cars.—SCHIEMANN.—A long communication pointing out that lead fuses in tram cars are not quite safe and that automatic cutouts should be used instead.—*Elek. Zeit.*, March 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Bolton.—The first part of a long very well illustrated description of the combined lighting and traction plant of Bolton, England. It was erected in 1894, using the alternating-current transformer system. When an electric tramway was decided upon, the opportunity was used to commence reconstruction on the 2 x 230 volts continuous current three-wire system, as far as the central district was concerned; when this is completed, the same machines will serve both for lighting and traction, the outlying districts, however, being still supplied with single-phase alternating current. It is stated that during last year 27 per cent. of the total units generated were wasted in magnetizing current.—Lond. *Elec.*, March 30.

Rates of Charging for Electric Supply.—LACKIE.—An abstract of a paper read before the Glasgow section of the British Inst. of Elec. Eng. The chief difficulty is to get the consumer to pay his fair share of the standing charges. On the whole, he considered that the Wright system had most nearly met the requirements of the case. He gives a comparison between the results of the gas and electricity departments in Glasgow; in the gas works the manufacturing charges amounted to 70 per cent. of the revenue, while the corresponding charges in the electricity department was 38 per cent.; interest and sinking fund in the case of the gas department amounted to 5 per cent. of the total revenue, while the same charges in the electricity department consumed 29 per cent. of the revenue.—Lond. *Elec. Eng.*, March 30; more briefly in Lond. *Elec. Rev.*, March 30.

Rates of Charging.—An article on the new rate of the City of London Electric Lighting Co. Every customer will be charged for the current which he consumes up to 12 kw-hours per year per 8-cp lamp fixed or its equivalent at the rate of 16 cents per kw-hour; all current consumed in excess of 12 kw-hours per 8-cp lamp will be charged at the very low rate of 4 cents per kw-hour. A comparison between the old and the new rate is given and the new one is sharply criticised from the commercial standpoint. It is also said that the scientific basis for the new rate is not sound, as there is a fault in the basis of reduction, which should be the maximum supply demanded rather than the equivalent 8-cp lamps fixed.—Lond. *Elec. Eng.*, March 30.

Systems of Charging.—An editorial note on the system of charging used in Wallingford, Conn. (ELEC. WORLD AND ENG., March 17, p. 393), stating that the writer is "quite unable to understand the reason underlying the system, or whether electricity meters are actually used or not. We defy any customer to obtain even an approximate idea as to whether he is being over or undercharged. Rates of this kind also tend to great waste of light, and consequently are not to be recommended in view of the fact that their only advantage is that meter rents are saved."—Lond. *Elec. Eng.*, March 30.

REFERENCES.

Current Specifications.—A series of articles giving abstracts of current specifications, with editorial comments on the general features and special clauses in the contracts. The first three articles deal with the specifications for the City of Leeds tramways; for the Dartford electric lighting plant, where a three-wire system is used with a pressure of 460 volts between the outers; for the Dublin plant, where a three-phase alternating current system is to be used for both lighting and power purposes.—Lond. *Elec. Rev.*, March 16, 23, 30.

Central Stations.—DOEPKE.—A paper on the installation of electric central stations, especially in smaller towns, containing three statistical tables.—*Elek. Anz.*, March 8, 15.

Paris Exposition.—An article on the production of electrical energy at the exposition. Two tables give the names of the builders and other data of the generators in the French and foreign sections. The systems of distribution are given (Digest, March 3, 10).—*El'ty*, April 11.

Another article on the exposition, with some illustrations of the electrical departments, in *West Elec.*, April 7.

Load Curves.—A reproduction of the load curves of the electric lighting plant of Newport, Monmouthshire, on the Christmas days from 1895 to 1899, which show an increase in arithmetical progression.—*Lightning*, March 22.

York.—The first part of an illustrated description of the municipal electric lighting plant of York. The three-wire system of distribution is used with a pressure of 230 volts at the consumers' lamps.—Lond. *Elec. Eng.*, March 23.

Great Britain.—MACKENZIE.—A brief abstract of a paper read before the Edinburgh Society of Science and Arts on the progress of electric lighting in the United Kingdom.—Lond. *Elec. Eng.*, March 23.

Greenock.—An illustrated description of this recently opened, continuous current municipal lighting station (Digest, Dec. 30, Jan. 6).—Lond. *Elec. Rev., Elec. Eng.*, March 30.

WIRES, WIRING AND CONDUITS.

Electric Wiring of Buildings.—A brief abstract of the discussion which followed the paper of Chamen (Digest, Feb. 24). Bathurst thought that the wood-casing system of wiring, although convenient for surface work, was utterly unreliable beneath floors or under plaster, and advocated the use of iron piping for the purpose. Chamen said the wiring might be done with perfect safety by the use of small porcelain insulators fixed in the rooms by means of ordinary wood screws. Denny said that his firm usually adopted the tree system of wiring, owing to the large number of wires required in the distribution box system; the great difficulty, however, was the moisture, but this could be got over by using "properly covered wires;" he thought that iron pipes as conduits were bad, they being simply water traps; probably the concentric system was the best for ship wiring. Clark very strongly advocated the use of "lead pipes for the wire conductors."—Lond. *Elec. Eng.*, March 23.

ELECTRO-PHYSICS AND MAGNETISM.

Thermoelectricity.—LIEBENOW.—A paper read before the Electrotechnical Society of Berlin. After an outline of the history of the two principles of thermodynamics, he gives briefly the results of his thermodynamical theory of thermoelectricity (Digest, July 29). He supposes that in a single metallic conductor, the ends of which are held at different temperatures, an e. m. f. is produced, so that the e. m. f. observed in a metallic couple is the difference of the two e. m. fs. produced in both metals. He reaches the conclusion that all metals become positively electric at the hot end, while all non-metallic elements, negatively; there is an analogous phenomenon in the electrolytic ionization theory, as all metal ions are assumed to be charged with positive electricity, all non-metallic elements with negative electricity. In a thermocouple, consisting of a metal and a non-metal, the e. m. fs. are added together, so that the e. m. f. of such a thermocouple is much larger than for two metals. The task of the practice should therefore be to find a metal or metallic alloy and a non-metallic element, for which the ratios of the conductivities for heat and electricity are the same; by forming a short circuited thermocouple of these, all heat which can be transformed into work according to the second principle of thermodynamics, will then be transformed into electrical energy; if one junction is at 1000° C., the other at the temperature of the room, this quantity of heat transformed into electrical energy is about 77 per cent. of the heat supplied to the hot junction. In a short circuited couple, however, all this electrical energy is again transformed into Joulean heat and is not available for work; to make it available for work, an external circuit is necessary; he calculates that in the case of greatest

economy not more than 28 to 29 per cent. of the whole heat supplied to the hot junction is available for heat. He thinks that even if only 15 per cent. would be obtained in practice, a thermoelectric power plant would be preferable to the present central stations, on account of its extreme simplicity and saving of room and attendance.—*Elek. Zeit.*, March 22.

Vacuum Electroscope.—Pfaum.—A description of an experiment showing that a vacuum acts like a perfect insulator. With a highly exhausted vessel he shows that electrostatic effects occur to a high degree, and that no luminosity could be detected under powerful inductive action.—*Ann. der Physik*, February; briefly abstracted in *Am. Jour. of Sc.*, April.

Rapid Spark Discharges.—Simon.—An account of experiments with the Wehnelt interrupter, giving photographs of lightning which showed successive discharges passing over parallel paths. It was found that a spark follows the same path as a preceding one, if the interval between the two does not exceed 0.0028 second. If the interval is larger, the spark follows a new zigzag path. This time interval appears to be independent of the length of the spark gap and of the material of the terminals.—*Gesellsch. Wiss. Göttingen*, 1899, p. 183; briefly abstracted in *Am. Jour. of Sc.*, April.

Röntgen Tube.—Kurlbaum.—A description of a new Röntgen tube with a Pabst anticathode. In order to keep the anticathode at a low temperature, it is covered electrolytically with platinum black, as this has a very great power of emission for heat rays, while that of platinum is very small.—*Elek. Zeit.*, March 22.

Potential Gradient.—Tuma.—An account of balloon measurements. The features are, that in some cases the potential gradients were reversed between particular altitudes, passing through zero values which in some cases were adhered to for some distances, in one case 600 meters, so that it seemed as if independently charged masses of air gave rise to the phenomenon; that the proportion of moisture in the air seemed to have nothing to do with this, and that even the presence of clouds does not determine any particular result; that the curve lines obtained are sometimes very jerky; that positive potential gradients fall off with increase of altitude and therefore positive charges are accumulated in the atmosphere; and that there was no disturbing charge on the balloon itself.—*Sitzber. Akad.*, Vienna, 108, p. 277; abstracted in *Science Abstracts*, February.

Potential Gradient During a Solar Total Eclipse.—Ludwig.—An account of observations made at Jeur, Deccan, Bombay Presidency, during the total eclipse of Jan. 22, 1898. The potential gradient fell from 150 to 120 volts per meter as totality was approaching, and went on falling to 89 for 30 minutes after it was over. The mean value before the darkness was 131. The gradient at Bombay was 64. The potential gradient clearly does not depend primarily on the temperature, and in order to support Elster and Geitel's photoelectric theory, Bombay being at a lower level, should have had a higher potential gradient than Jeur, and during an eclipse the potential gradient should have risen.—*Sitzber. Akad.*, Vienna, 108, p. 436; abstracted in *Science Abstracts*, February.

Potential Gradients in Egypt.—Exner.—A long paper discussing the various theories of the atmospheric potential gradient. His formula that the normal potential gradient is inversely proportional to $1 + K p$, in which p is the proportion of water vapor in the air, is now amply confirmed. He gives strong reasons against Hallwachs' photoelectric theory and against Braun's theory that the potential gradient falls with rising temperatures.—*Sitzber. Akad.*, Vienna, 108, p. 371; abstracted in *Science Abstracts*, February.

Potential Gradient in Siberia.—Benndorf.—An account of observations of atmospheric potential gradient at Tornsk in midwinter. The results do not fully confirm any existing theory, but may be to some extent harmonized with them, if dry ice or snow have, as Brillonia claims, a negative-electricity-discharging sensitiveness to light about one-twentieth that of zinc.—*Sitzber. Akad.*, Vienna, 108, p. 341; briefly noticed in *Science Abstracts*, February.

REFERENCES.

Dispersion of Static Electricity From Points.—Sieveking.—An abstract of a dissertation, giving an account of measurements of the quantities of positive and negative electricity which are dispersed in a given time from a point charged at a given potential, to a disc at a given distance in different gases.—*Elek. Zeit.*, March 22.

Rarefied Gases.—Bouty.—An English translation in full of his paper on the question whether rarefied gases are electrolytes, noticed in the Digest Feb. 3. Also an editorial note concluding that J. J. Thomson's position has not been touched by Bouty's experiments.—Lond. *Elec.*, March 23.

Experiments Illustrating Syntony.—Shaw.—A brief abstract of a British Physical Society paper, describing some lecture-room experiments which show the principles of magnetic space telegraphy.—Lond. *Elec. Rev.*, March 30.

Localization of Energy.—Volterra.—A paper in which Poynting's method of localizing the electromagnetic energy (by which he developed a theory of the flux of the energy in an electromagnetic field) is applied to the case of gravitational attraction.—*Nuovo Cimento*, November; briefly abstracted in Lond. *Elec.*, March 23.

Terrestrial Magnetism.—The March issue contains the first part of a paper by Bauer and Hazard on the physical decomposition of the permanent magnetic field of the United States, dealing with the assumed normal magnetization and the characteristic of the primary residual field; an article in German by Bauer on the task of the U. S. investigation of terrestrial magnetism; a biographical sketch of the late Alexis de Tillo, with portrait; a German paper by Schmidt, giving some hints as to the arrangement of simultaneous observations of terrestrial magnetism, in order to find out the causes of the disturbances of terrestrial magnetism; a comparison of the isogonic charts for the year 1900, issued by the Deutsche Seewarte, the U. S. Hydrographic Office, and the U. S. Coast and Geodetic Survey, by Fleming; an illustrated article by Preston on the origin, development and present status of the U. S. Coast and Geodetic Survey; three illustrated notes regarding magnetic instruments by Morice, Bauer and Fischer.—*Ter. Mag.*, March.

Electro-Chemistry and Batteries.

Carborundum.—A note stating that the increased output of carborundum in 1899 over 1898 is about 50,000 lbs. The inside dimensions of the carborundum furnaces of to-day are 16 feet long, 6½ feet wide and 5 feet deep. The raw material is piled 4 feet above the top of the furnace. One thousand electrical horse-power is applied to the furnace for 36 hours, during which time it is estimated that the furnace gives off no less than 7 tons of carbon monoxide gas.—Lond. *Elec. Rev.*, March 30.

Potential Difference Between Metals and Non-Aqueous Solutions.—Kahlenberg.—An account of measurements with metals immersed in non-aqueous solutions of salts. In the case of solutions containing the same quantity of salt per liter, the potential difference appears to depend upon the nature of the solvent; solvents of a similar chemical nature give results which are nearly the same. As a rule, the solution tension of the metals for these various solutions cannot be graduated for lack of data. Many contradictory results are found from which it appears that if the osmotic pressure theory is correct, the solution tension must vary with the solvent.—*Jour. Phys. Chem.*, 3, p. 379; abstracted in *Science Abstracts*, February.

REFERENCES.

Storage Batteries.—Sieg.—A paper illustrated by diagrams, read before the Electrotechnical Society of Cologne. He gives some general rules for choosing the size and type of a battery for a central station. The influence of the internal resistance of the cell which is the sum of the resistances of the acid and of the positive and negative plate, is discussed and an account of measurements made by Schoop is given (Digest, April 7).—*Elek. Zeit.*, March 15.

Engraving by Electricity.—Riedder.—A long illustrated article on the method described in the Digest Jan. 13.—*Elek. Anz.*, March 11, 18.

Silver Plating of Amalgam Plates for Gold Mills.—Clark.—A description of an electrolytic method used for replating the silver plated amalgam plates of the mills of a mining company in Lead City, S. D., after they had shown a decrease in recovery of gold when the original plating has begun to wear off.—*School of Mines Quart.*, 21, p. 48; abstracted at some length in *Tech. Quart.*, March.

Decomposition of Chloride of Sodium.—Lorentz and Wehrlin.—Continuations and conclusion of their long article, noticed in the Digest Feb. 24.—*Zeit. fuer Elektrochemie*, Feb. 1, 8, 22, March 1, 8.

Gas Cells.—Bose.—A brief illustrated article on gas concentration cells and a new type of gravitation cells. The article is of theoretical but not of practical interest.—*Phys. Zeit.*, Feb. 17.

Electrolysis of Iodides.—Lewin.—A long abstract of a dissertation, giving an account of a long series of measurements. The results are given in a table and some general conclusions are drawn.—*Zeit. fuer Elektrochemie*, March 8.

Electrochemistry in 1899.—KRUEGER.—A longer abstract of the German article noticed in the Digest March 10.—*Eng. Mag.*, April.

Storage Battery Problems.—WADE.—The second half of his long paper, abstracted in the Digest April 14. This part is mainly theoretical and deals with the purely chemical characteristics of lead compounds.—Lond. *Elec. Eng.*, March 30; the first part of the second half of the paper also in Lond. *Elec.*, March 30; the first part of the discussion which followed, is abstracted in Lond. *Elec. Rev.* and *Elec. Eng.*, March 30; also a separate article on the paper in Lond. *Elec. Rev.*, March 30.

Connection of Cells.—VOGEL.—A brief mathematical article on the connection in parallel of several series groups of cells. He develops formulas for some problems, such as the determination of the minimum number of cells necessary to give a certain current in a given external resistance.—*Centralbl. fuer Accum.*, Jan. 1.

E. M. F. of Concentrated Cells.—TREVOR.—An investigation of the effect of the heat of dilution on the general equations expressing the relation between e. m. f., concentration and temperature.—*J. Phys. Chem.*, 3, p. 95.

Sandmeyer-Gattermann Reaction.—A description of an improvement devised by Votocek and Zenicek who use electrolysis, for the production of chlorine products from amido combinations.—*Elek. Anz.*, March 15.

Electrometallurgy.—KERSHAW.—An article on the progress of electrometallurgy in Europe in 1899 (see also Digest, Jan. 27, Feb. 3, 10).—*El'ty*, April 11.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Wheatstone Bridge.—A well illustrated description of a Wheatstone bridge devised by Fleming, for use as a workshop instrument. There are no exposed ebonite or metal parts, except three pairs of terminals. The resistance coils, which are arranged on the dial pattern, are formed as follows: the bobbin consists of two hollow half cylinders of thin sheet copper each having a lug, which are put together with a thin separating piece of ebonite and bound together with a thin silk tape; the two ends of the resistance wire of manganin are soldered to the two lugs of the copper half cylinders, the wire being wound non-inductively on the bobbin and tied in position by a thin silk tape. The outer surface of the box shows only sets of small holes arranged in circles and marked respectively units, tens, hundreds. In order to prevent dust getting into the holes between the brass blocks, there is a special contrivance in the form of a self-closing shutter, which is described. The plug has a semi-circular groove turned in it at such a height in the plug that when in place the top of the block is just on a level with the middle of the groove, which is an effective cure for "shouldering" in the plugs.—Lond. *Elec.*, March 30.

REFERENCES.

Standard Cells.—JAEGER.—A very long and rather full summary. In the first part he deals with the general properties of a standard cell and gives theoretical notes on the calculation of the e. m. f. from the heat tonings, on the influence of the temperature coefficient of the e. m. f., on the dependence of the e. m. f. upon the concentration of the electrolyte, and gives a brief outline of the osmotic theory of the galvanic cell. In the second illustrated part of the article special types of standard cells are described and rules are given for the preparation of Clark cells. He then discusses more briefly cells with a smaller temperature coefficient; the Clark cell with dilute electrolyte, the Gouy cell, the calomel cell, and the Warren de la Rue cell, and describes finally at some length the Weston cell.—*Centralbl. fuer Accum.*, Jan. 1, 15, Feb. 1, 15.

Three Voltmeter Method.—Explanations, illustrated by diagrams, of the three voltmeter method of measuring power consumed in the primary coil of an alternating current transformer.—Lond. *Elec. Eng.*, March 23.

Meters.—A. H.—An illustrated article on the installation of a station for testing meters.—*Elek. Anz.*, March 18.

TELEGRAPHY, TELEPHONY AND SIGNALS

Electric Tramways and Submarine Cables.—Two communications, referring to the paper and letter of Jamieson (March 31, April 14). The first communication, by Hay, claims that electromagnetic induction under the conditions of the Cape Town cables, is practically impossible; in the experiments referred to in Jamieson's letter, electromagnetic induction is due simply to the position of the return part of the circuit. The second anonymous communication agrees that Jamieson's theory as to the inductive action being the effect of the sum of the differences of the fields of the primary currents at the centre of the conductor, is probably correct, and adds two remarks: first, that twin parallel cores are as efficacious in overcoming the induction effect as twin twisted cores; second, that in Jamieson's experiments the disturbing currents are shown as entering the sheathing of the cable at points embraced by the anti-induction twin core; the question is asked how it would be if the leakage currents from the tramway rails cut the cable sheathing beyond the anti-inductive shore end. It seems probable that the area disturbed will vary in every instance, depending upon the relative positions of the cable end, power house and rails, the strength of the currents used, and the nature of the soil, subsoil and geological strata at the place affected.—Lond. *Elec.*, March 30.

REFERENCES.

Telephone Patents.—An article summing up the patent situation in telephony.—*Tel. Mag.*, March.

Telephone Exchange Inspection.—DOBBS.—An illustrated article pointing out the value of an occasional inspection of instruments and apparatus and giving some hints how best to do it.—*Tel. Mag.*, March.

Country Party Lines.—An illustrated description of a telephone specially adapted for country party lines and farmers' lines.—*Tel. Mag.*, March.

Youngstown.—An illustrated description of the plant and system of the Youngstown, O., Peoples' Telephone Co. (independent) which is said to be one of the most perfect ever built. The exchange is equipped with the central energy system and multiple switchboard apparatus.—*Tel. Mag.*, March.

Pacific Cable.—Some abstracts of a communication of Mr. H. Emerson to the Senate Committee on Naval Affairs, who favors the northern route for a Pacific cable (Digest, Nov. 18), giving some information as to the cost of construction of ocean cables.—*India Rubber World*, April 1.

MISCELLANEOUS.

Copper Standards.—A note abstracting the editorial remarks in the ELEC. WORLD AND ENG., March 17, and adding: "We quite agree with our contemporary in the advantage of having a world-wide standard, but we do not expect that the British manufacturers, or even the manufacturers in America will give up the Fahrenheit scale of temperature or adopt the metric system of weights and measures at the dictation of the committee meeting in Paris."—Lond. *Elec. Eng.*, March 30.

Municipal Trading.—An abstract of a discussion of the London Chamber of Commerce. Mayor Flood-Page said that municipal enterprise should be confined to doing everything that will result in a gain and not a loss to all the ratepayers; the extension of municipal trading might be very dangerous on account of political influence, as politics played a considerable part in our commercial life. Lord Avebury thought it is undesirable that either the state of municipalities should be involved in labor problems more than can be avoided, and it would also be a great check to progress. Similar opinions were expressed by other speakers and Mayor Flood-Page summed up the debate by saying that the whole enterprise of the empire was at stake.—Lond. *Elec. Eng.*, March 23.

REFERENCES.

India Rubber.—DEISS.—A brief abstract of a paper read before the Society of Civil Engineers of France, describing a new process for the extraction of india rubber from the bark and roots, by which it is claimed that one pound can be "produced" at a cost of about 2½ cents (presumably referring only to the cost of extraction).—Lond. *Elec. Eng.*, March 23.

Directory of Electrical Societies, Etc.

CHICAGO ELECTRICAL ASSOCIATION. Next meeting, April 20. Paper, "Voltage Equalizers for Three-Wire Systems," by F. S. Hickok.

NEW YORK ELECTRICAL SOCIETY. Next meeting at the College of the City of New York, 8 p. m., April 20. Paper, "Electrolysis as Caused by the Electrical Railway Ground Returns," by Albert B. Herrick.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Next meeting, April 25. Paper, "Hysteresis in Sheet Iron and Steel," by Arthur H. Ford.

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN

New Books.

ELEKTRISCHE STRASSENBAHN. Electric Tramways. Tramways Electrique. 1900. Berlin: Allgemeine Elektricitats Gesellschaft. 400 pages, 9½ in. by 12 in., profusely illustrated.

This work, issued by the Allgemeine Elektricitats Gesellschaft of Berlin, for purchasers connected with the street railway industries, is perhaps the handsomest trade catalogue that has ever been compiled by any company. The catalogue contains 400 pages, is bound with heavy board covers and printed on fine coated paper, many pages having a preliminary tint before the illustrations are printed upon them.

The book is divided into the following parts: First, the introduction, to which four pages are devoted; second, a discussion of the various systems of tramways and the advantages of electric traction; third, a large section devoted to the description of the equipment and apparatus for electric tramways manufactured by the Allgemeine Elektricitats Gesellschaft; fourth, a most interesting section consisting of notes and illustrations of electric tramways built by the Allgemeine Company in the principal cities of Europe and South America; fifth, a description of electric locomotives and special electric railways built and installed by the company, and lastly, a list of Allgemeine electric railways at present in course of construction.

There are three columns to a page, the first in German, the second in French and the third English. The typographical work is in two colors. The book is profusely illustrated, and the illustrations are devoted not only to dynamos and motors made by the Allgemeine Elektricitats Gesellschaft, but page after page is devoted to engineering work which has been performed directly or indirectly by the company in the construction of the many roads on which their apparatus is used.

These notes, as they are recalled, are very complete and in most cases comprise the following information: First, a map of the road; second, the equipment, plant capacity, gross receipts and the car mileage for various years; and, lastly, the length of single track. This is supplemented by drawings of the gradients of the various parts of the road suitably numbered and provided with scales of heights and distances. The description is usually accompanied by fine illustrations of the power house, car barns, depots and such portions of the road as involve interesting engineering work.

The section of the book devoted to the company's railway machinery is well illustrated by cuts of their motors, dynamos, overhead material and the various methods of track construction employed. There is also shown a fine selection of controller diagrams, connections and illustrations. A few pictures of shop facilities are also in the catalogue, and it may be remarked that the work which the catalogue illustrates implies facilities of the highest order and great magnitude.

To those who have been under the impression that the tramways of Europe are few and far between, the book will prove a surprise. It shows conclusively that there is a great deal of good electric railway engineering being done in prominent European cities by this company. Many of the illustrations are of great beauty, and while they refer only to the electric tramways of the company, they incidentally display the scenery of some of the most beautiful and famous spots in Europe.

The section devoted to electric locomotives is very interesting. It describes locomotives for passenger traffic, switching work for mining and for freight, and passenger transportation of various kinds. A locomotive for three-phase currents is shown and still another which is propelled by storage batteries. In the latter part of the book are pictures of electric railways involving special engineering in their construction. They are mostly of the elevated and underground type and are most generously illustrated.

The table of tramways in progress and in operation comprises the following items: 1. The location. 2. The inhabitants. 3. Date of building. 4. Date of completion. 5. Name of the operating firm. 6. The length of the lines. 7. The length of single track. 8. The gauge. 9. The type of rails. 10. The steepest grade. 11. The number of motor cars. 12. The number of trail cars. 13. The number of motors. 14. The number of boilers. 15. Heating surfaces of each in square meters. 16. Number of engines. 17. Horse-power of each. 18. Total horse-power of each output. 19. Number of generators. 20. Voltage. 21. Total output of generators in kilowatts.

The book of course has its value as a catalogue of the goods of the Allegemeine Elektricitats Gesellschaft, but it is also one that will be preserved by those engineers fortunate enough to possess it as a reference book of high value.

BOOK RECEIVED.

TRASMISION ELEKTRIKA DE POTENZIA A LARGAS DISTANZIAS. Sobre La Manera De Kalkular Industrialmente Este Jenero De Instalaziones. Por A. E. Salazar, Professor De Fisika Industraial De La Unibersidad De Chile. Kon Una Tabla Orijinal Sobre El Konsumo De Kobre En Las Trasmisiones Polifases. Santiago de Chile: Hume & Company. 95 pages.

Electric Signals for Railways.

BY CLARENCE A. STIMPSON.

WITHIN recent years there has been no greater development in any one branch of the application of electricity than in that devoted to the service of electric railways. Inventors and electricians in this great field have heretofore almost universally applied themselves to the heavier parts, such as controllers, brakes, motors, etc., while comparatively little attention has been given to the signal and block systems, which are such important factors in the proper and safe movements of cars.

The demand for some safe automatic device is apparent from the numerous accidents that occur every year, which, in many instances are due to the lack of a proper signaling system. During the summer months, when suburban electric railways are carrying their greatest number of passengers, instances of these accidents are frequently

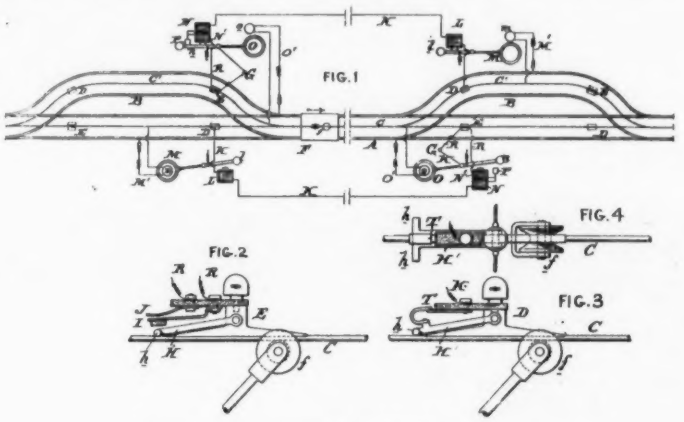


DIAGRAM OF ELECTRIC RAILWAY SIGNALS.

noticed in the columns of the daily papers, and the blame invariably falls to a defective signal system or to no signals at all. This is especially true of single track roads, where cars run in opposite directions, with turnouts placed at certain distances apart.

The employment of the trucks to operate any signal device where the trolley runs along the public highway has been found defective, in that heavy teams which have the use of the road are likely to interfere with the switches.

A device has recently been patented whereby an overhead system is employed, which utilizes the trolley pole for opening and closing a circuit to operate the signals. It is not only very simple and cheap of construction, but has also proved itself of practical value. It consists of two switches, fastened to the trolley wire in the manner of the ordinary ear and insulator and insulated with molded mica from the trolley wire itself. The contact points for opening and closing the circuit are incased in an airtight metallic cover, and the lever, resting on the trolley wire, is insulated. The points are arranged to make a sliding connection, thus preventing oxidization and maintaining a bright surface.

The signal circuit requires less than 50 milliamperes of current, which is taken directly from the feed wire or the trolley itself, and passes through a cylindrical resistance coil with a metallic covering, attached to the pole adjacent to the signal box. The current is reduced to one-half an ampere in the lamp circuit, sufficient to run one 16-cp incandescent lamp, and tapped in such a manner as not to perceptibly increase or diminish the power of the lamp, or the current on the signal wire.

The signal box is of metal, and is made bug and watertight, and equipped with relays. An armature throws a screen of colored silk or glass in front of the incandescent lamp, thus showing a powerful

red, green or white light through the bull's-eye, and at the same time operating a semaphore.

A car on entering a block, opens a normally closed switch, simultaneously sets the home and distant signals at "Danger," thus announcing its presence on that block to any car which may be following, or coming toward it from the opposite direction. As the car passes out of the block and under the distant switch, it resets both these signals at "Safety." The same operation is performed on entering into the next block, and so on.

One of the main advantages offered by this system lies in the fact that no part of the equipment requires outside handling, and that all of its working parts are under cover and out of the reach of any disinterested or maliciously inclined person. By reference to the accompanying cut a better theoretical idea of the working of the system may be obtained.

Fig. 1 is a plan view of the tracks and circuits. Fig. 2 is an enlarged view of the distant trolley ground switch. Fig. 3 is the home normally closed switch, and Fig. 4 is a plan view of the same.

A is the main line track, which has at intervals in its length turnout sections *B B*. *C* is the main trolley conductor, and *C'* the turnout trolley conductors, these being constructed in any well known manner. *F* is a trolley car and *f* the trolley pole. In describing the signal circuits in connection with the main line, it is to be understood that the signal circuits between the successive turnouts are precisely the same as those of the main line, with the exception that they are reversed, because the cars are running in opposite directions in the two instances.

The main line signal circuit is indicated by *K*, and connects at one end with a normally closed switch *D* (more clearly shown in Figs. 3 and 4) and at the other or distant end the line circuit connects, through an electromagnet *N* and a ground switch made up of a contact *P* and an armature *n*, with the ground at *G*. A shunt circuit *R* connects with the main line *K* adjacent to the ground contact *P* and includes the coils *N'* of the electromagnet *N* and also connects with the ground through a normally open ground switch *E* (best shown in Fig. 2).

The armature *n* operates a semaphore *O*, which may be of red glass or red fabric, and which passes in front of or to one side of an electric or other lamp, *O*. If an electric lamp is employed, it may be energized from the trolley circuit by a light circuit *O'*; any ordinary white light may be employed, if desired. At the other or home end of the circuit is arranged an electromagnet *L* which operates an armature 1 connected with a semaphore *M* similar to that last described, and adapted to change the color of the white light into the red danger signal, whenever the magnet *M* is demagnetized. The normally closed home switch *D* consists of an arm *H* pivoted, and having lateral projections *h* adapted to be pressed upward by the wheel of the trolley pole *f* as the car passes under it.

When the arm *H* is pressed upward it opens the normally closed switch *T*, and interrupts the current in the line signal circuit *K*, thereby simultaneously demagnetizing the electromagnet *L* and the electromagnet *N*; both armatures of these electromagnets then fall away from their magnets and throw the semaphore to danger. The distant ground switch *E* (best shown in Fig. 2), comprises a similar pivoted arm *H*, which is raised by the passing trolley and brings the switch terminals *I*, *J*, into contact for closing the shunt ground *R*. Upon closing the circuit *R* it will be seen that the current will then pass over the line *K* through the main coils of magnet *N* to ground. This will instantly cause the armature I at the home station and the armature *n* at the distant station to be drawn up and the signals thrown to "safety."

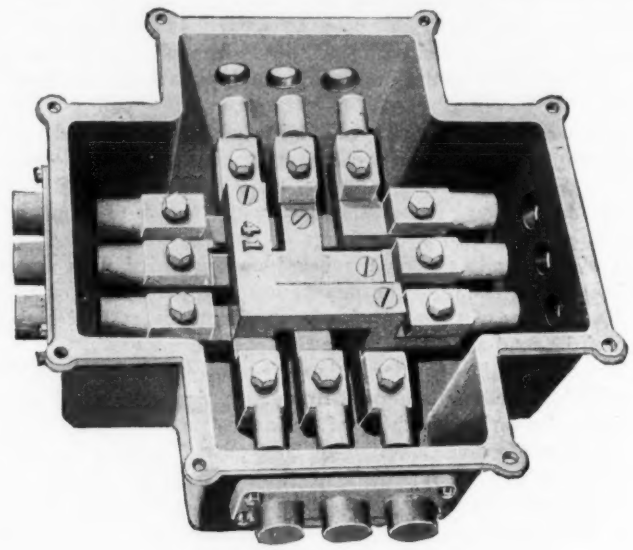
While it has been shown that this system is especially adapted to single track roads with turnouts, it is self-evident that it may be employed as a block system for single tracks without turnouts, or for straight double tracks.

Underground Material.

In view of the usual extensive spring additions to underground systems the General Incandescent Arc Light Company, New York, has made ready for the market an improved line of Ferguson safety catches and Tailleur junction, service and coupling boxes. The junction boxes are designed for use on underground low tension three-wire systems where the boxes are located in manholes at street corners, at the intersection of two or more lines. The junction box furnishes a ready means for opening up lines to locate trouble, and also acts as a safety device in case of trouble, since each line leaving the box is provided with a safety fuse. A four-way box is used where two or four mains meet, and a 6-way or 10-way box where a feeder from the station feeds into the net work, and where provision must be made for more than four mains. The general construction of these boxes is shown by the accompanying illustration. The box itself is of cast iron, the door being hinged, and when closed is held tight against the rubber gasket by means of thumb screws.

There are three busbars—one each for the postitive, negative and neutral side of the system. Directly below the bars are the cable terminals screwed to insulating blocks. The connection between the busbar and the cable terminal is made by means of a Ferguson safety catch. The busbars are not arranged one directly above the other, but are offset, the top or neutral bar being at the back of the box, the positive bar below and in the middle, and the negative bar at the bottom and directly in the front of the box. This gives a clear space between bars, and if a workman should accidentally drop a fuse or nut while working on any one of the bars it would drop clear and there would be no danger of a short circuit. The bars are rigidly supported on and thoroughly insulated from the iron beams. The carrying capacity of the positive and negative bars is 2000 amperes and of the neutral 1000 amperes.

The box is so constructed that any single part of it can be readily removed without disturbing any other part. Each cable terminal is drilled for a taper plug with a corresponding taper hole in each



TAILLEUR SERVICE BOX.

busbar, so that a flexible cable, about one foot long, with taper plugs at each end, can be used as a jumper round the fuse, thus avoiding any danger from arcing when taking out or replacing a fuse on a line which might be carrying a heavy current.

There are three eight-candle lamps permanently located on the inside of the box, two of which are test lamps and have flexible leads, and the third for automatically lighting the box and manhole when the door of the junction box is opened. These lamps in the junction box do away with the repair men carrying test lamps, and thus very much reduce the danger from gas explosions in manholes caused by other means of lighting. In case a feeder is connected into the 6-way and 10-way boxes, connections are provided for pressure wires, but this provision is not made in the 4-way boxes, unless specially ordered. The cables are brought into the box through an opening in the bottom made water-tight by means of a gland or bushing around the cable. This gland has a rubber gasket between it and the box, and is also filled with compound from the inside.

The illustration shows a Tailleur service box for use on low-tension systems where cable mains are used. The box as commonly used is 4-way 3-pole, and is located in a handhole built on top of the cable conduit, the top tier duct in the conduit being used for the mains. No fuses are used with this box, as the object of it is to do away with cable joints as much as possible. In case of trouble on a main it is easy to locate, and also to disconnect that part of the main giving trouble, without cutting the cable. The carrying capacity of the box is 500 amperes per leg.

Workshop Polyphase Motor Equipment.

Recently it became necessary for the Cleveland Twist Drill Company to very materially enlarge its factory, and it was decided to take advantage of the occasion to thoroughly remodel the power distributing system. After having carefully gone over the situation with a competent consulting engineer, it was decided to install a polyphase plant and to distribute the power by induction motors.

A new power house, measuring 80 feet by 40 feet, was constructed, in which half of the space is devoted to the boilers and their accessories, and the other half to the generating machinery, as seen in the diagram, Fig. 2. The boiler room has been provided with the most modern improvements for labor saving and for mechanical operation. Two water tube boilers of 150-hp capacity each, provide steam at 140 pounds pressure, and mechanical stokers feed the furnaces. The coal supply has been given great attention. Coal cars dump their contents into a coal crusher in the basement of the boiler room, and the coal is thence conveyed by an endless chain of buckets to the coal bunkers above the boiler room, these bunkers having a capacity of 350 tons. The coal falls by gravity into the hoppers attached to the mechanical stokers, and in passing down, the weight of the fuel is taken and the amount consumed by each boiler accurately recorded. As the ashes are dumped from the stokers they are carried by an endless chain of buckets to the upper floor of the building and thence shot into a receptacle having a capacity of about 50 tons, and are discharged into cars alongside the building.

The electrical equipment has been supplied by the Westinghouse Electric & Manufacturing Company. The generating room contains one 150-kw, two-phase, 220-volt, 7200-alternation engine-type generator, which is direct connected to a 250-hp horizontal tandem compound engine running at 240 r. p. m. A view of this unit is shown in Fig. 1. A direct-current, compound wound, multipolar generator is belted to the engine shaft, furnishing current to excite the larger generator at a speed of 875 r. p. m.

The feeder circuits are carried from the switchboard into the basement of the power house, and thence are conducted by two underground conduits to the basements of the various departments of the works. The conduits have been very substantially constructed, one of them being 160 feet and the other 95 feet in length. They are 6 feet high with a width of 4 feet. The walls are of brick with stone slab top. These conduits serve not only for the electric feed wires, but also for the steam pipes for heating the buildings with the exhaust steam, and afford great facilities for repairs in case any of these pipes should leak.

Provision has been made for supplying electric current to 1000 incandescent and 10 arc lights distributed throughout the buildings.

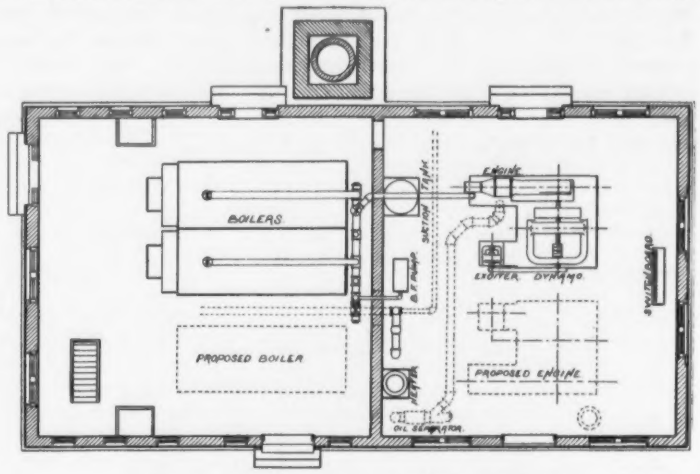


FIG. 2.—GROUND PLAN OF POWER HOUSE.

The potential from the generator is 220 volts, which is conveyed to auto-transformers and reduced for the 110-volt lamps. The engineer has very ingeniously devised the lighting circuits so as at all times to bring an equal load upon each phase of the generator. The factory is divided for lighting purposes into three sections, it being built in "U" shape three stories high, the power house completing the fourth side. On the middle floor of each section are placed two auto-transformers. In each section there are about 300 lamps, bringing about 150 lights on each auto-transformer, or 75 lights on each side of the transformer. Reference to the diagram Fig. 3 shows the wiring to be so arranged that divisions 1 and 4 are fed from auto-transformer *A*, and divisions 2 and 3 are fed from auto-transformer *B*. The object of this device is to prevent unbalancing of the circuits, as should the lights on any entire side of the building be thrown off the system would not be unbalanced.

An entire change has been made in operating the various floors of the manufacturing departments, by abandoning the former

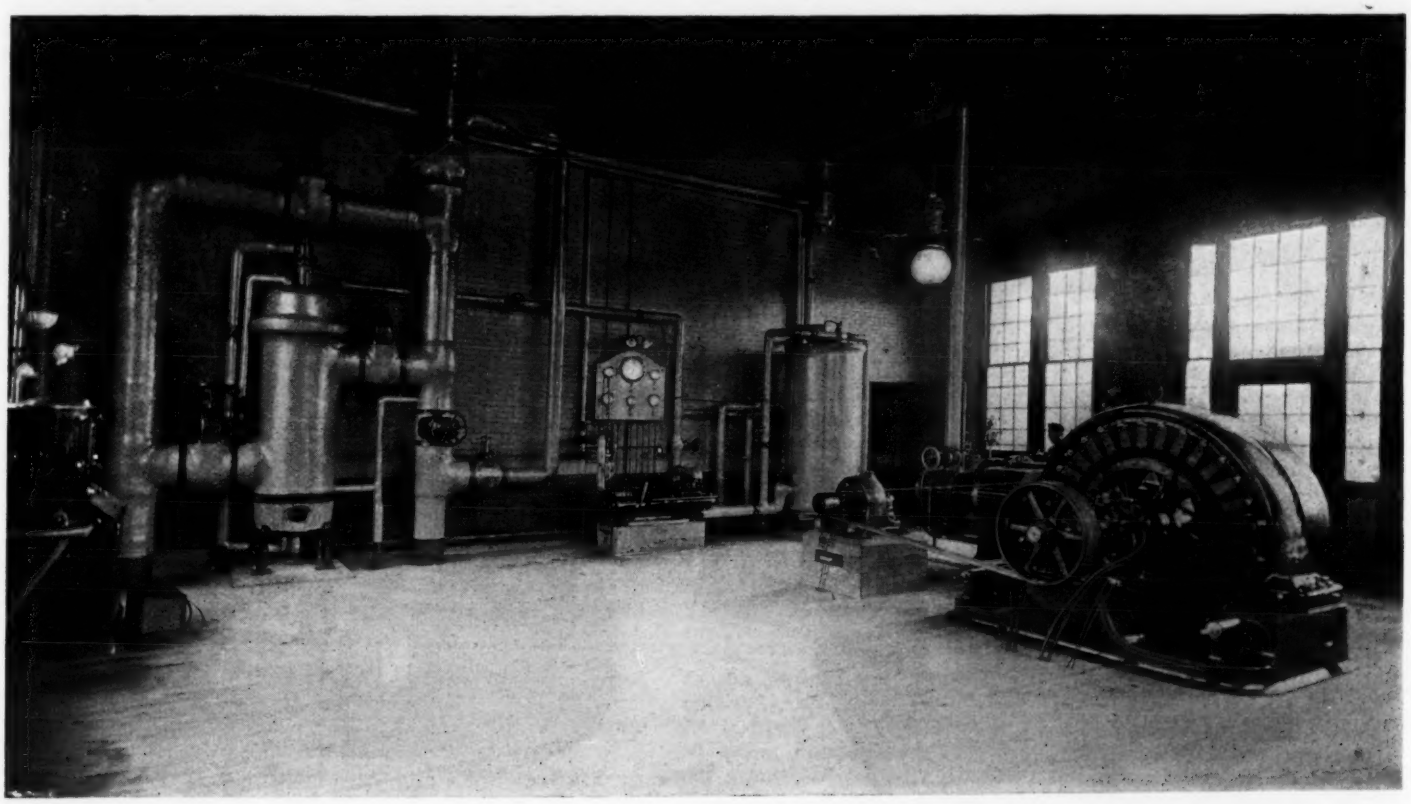


FIG. 1.—DYNAMO ROOM, CLEVELAND TWIST DRILL COMPANY.

steam drive and substituting lighter shafting directly driven by induction motors, a number of which have been installed. The motors are placed upon platforms suspended from the ceiling, thus occupying no valuable floor space. It is of more than usual interest to note the generally improved appearance of the factory where these motors are in operation. Apart from the fact that the introduction of electricity makes a great saving in the cost of fuel, the surroundings of the factory experience a marked improvement, a far more steady and efficient light being provided, and induction motors are practically noiseless and are very cleanly. It has been found that operatives in these improved sanitary surroundings can do a better day's work.

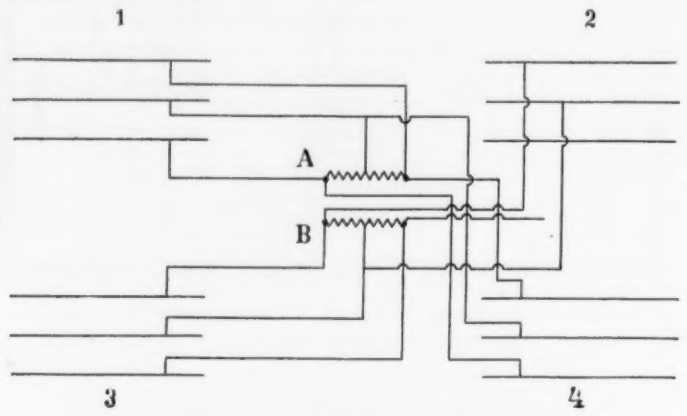
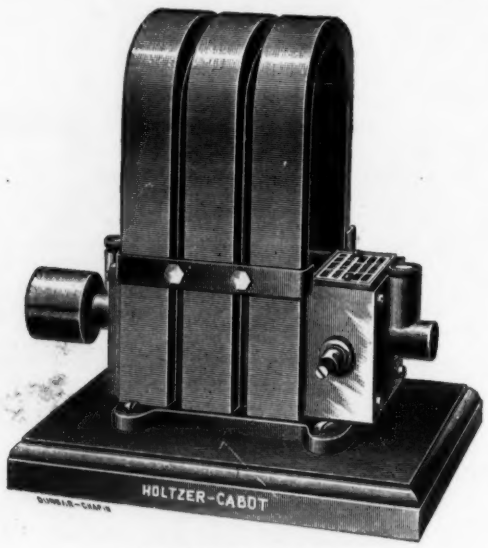


FIG. 3.—WIRING FOR BALANCING LIGHTING CIRCUITS.

The motors run continuously if oiled once in three months, and a little attention is given to cleaning. They will carry a considerable overload, but if this becomes too excessive they stop, and as there are no commutators, brushes or other contact parts, there is no fear of sparking nor burning out of the insulation. At starting these motors develop two to two and a half times their rate of full load torque.

Dynamo Gas Engine Igniter.

The dynamo gas engine igniter shown herewith is constructed with a permanent magnet field and an armature of the drum type. It has self-feeding carbon brushes, and is self-lubricating, being



GAS ENGINE IGNITER.

provided with grease cups. This igniter is especially adapted for marine work, the armature being inclosed, and dirt, oil and moisture proof. It can be run in either direction, and if the flywheel of an engine runs true, it may be driven from a friction pulley bearing upon the rim, or may be belted to the flywheel or to any convenient line of shafting. The normal speed is about 2000 r. p. m., but it can be used satisfactorily at any speed down to 1500 r. p. m.

In starting up a gas engine, a battery is used for a few moments, and for this purpose the manufacturers, the Holtzer-Cabot Electric Company, of Boston, supply the battery especially adapted to this purpose.

Within the past year, the Holtzer-Cabot Co. has had a great many inquiries for smaller igniters, especially for automobile gasoline motors. To meet these demands, it has just completed final experiments on an igniter of this type and is now ready to supply a small igniter called the "Automobile Type." It is a complete magneto dynamo, weighing less than ten pounds, the dimensions being 7½ inches high, 4 inches wide and 7 inches long.

Portable Testing Set.

While the instrument illustrated herewith has been on the market for several years, yet, in the present form, as shown, some decided improvements are included.

By common consent the term "portable testing set" has come to be applied to a combination instrument for resistance measurements embodying in one small case a Wheatstone bridge, rheostat, galvanometer, battery, keys for galvanometer and battery, and terminals, to which the resistance to be measured should be attached. Such an instrument, if properly constructed, has a wide range of usefulness. In the set illustrated, the rheostat contains 16 coils, ranging in resistance from 1 to 4000 ohms and having total capacity of 11,110 ohms. The Wheatstone bridge consists of coils of 1, 10 and 100 ohms on one arm and 10, 100 and 1000 ohms on the other. A bridge reversing device enables any ratio to be obtained that is possible with a bridge having coils of 1, 10, 100 and 1000 ohms on each arm. The rheostat coils are guaranteed accurate within 1-5 of 1 per cent. and the bridge coils within 1-10 of 1 per cent. The galvanometer is of the D'Arsonval type which is so valuable because of being unaffected to an appreciable extent by surrounding mechanical and electrical disturbances. Furthermore, it is dead-beat, so that measurements can be made very quickly. A few cells of special dry battery supply necessary current for all ordinary measurements.

Because of the high sensibility of the D'Arsonval galvanometer which forms part of this set (this sensibility being in excess of 1 megohm) it is possible to make measurements with a degree of accuracy of from 1 per cent. at .01 ohm to 1-5 per cent. at 100,000 ohms, and 3 per cent. at one megohm. The error of 3 per cent. in

PORTABLE TESTING SET.

measuring resistance of about 1 megohm can be very much reduced if an auxiliary battery of 50 cells or more is employed. In fact, when making tests between 1 megohm and 11 megohms, the latter representing the theoretical limit of the apparatus, a battery of 50 or 100 cells should be used without doubt and under such conditions surprisingly satisfactory work can be done.

The instrument described, known as the "Jagabi," is made by Morris E. Leeds & Co., and sold by James G. Biddle, Drexel Building, Philadelphia.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—During the past week the tendency exhibited the week previous on the part of railroad and leading industrial stocks to move with more or less independence of each other was more pronounced. Local traction stocks also contributed to the irregularity of the situation by an independent development of strength. The quotations of some of the more active railroad stocks were higher at the close of the week than they were at the close of the previous week, while many industrials were decidedly lower. Most of the activity in the industrial division centered in the steel stocks, and American Steel and Wire shares were the weak feature. Its weakness naturally affected other stocks of its class. Early in the week there was a renewal of the rumor that the Metropolitan Street Railway Company had acquired large holdings in Brooklyn Rapid Transit. The advance of the latter was promptly checked by prompt denials of the report. The traction stocks were, however, strong, and Third Avenue distinguished itself by rising sharply to 118 on the announcement that a $35,000,000 bond issue had been negotiated through the Metropolitan's aid, to provide for the floating debt. The succeeding announcement that the lease of the road to the Metropolitan left dividends on the stock in doubt for four years caused, however, a recession in the price. The bank statement of Saturday offset the large decrease in cash holdings reported in the statement of the week previous, by showing a cash increase, larger by a million and a half than the figures of Friday foreshadowed, and this in spite of a $500,000 export of gold on Monday. In the dealings in general electrical stocks American District Telegraph was unchanged at 27, with sales of 200 shares; American Telegraph and Cable closed at 91, representing a net loss of ¾ point; Brooklyn Rapid Transit's highest quotation was 80½ and the lowest 75¾, the latter being also the closing price; the net gain for the week was ⅞ point. The sales amounted to 199,471 shares. General Electric was not much traded in, the sales amounting to 6420 shares, the highest, lowest and closing quotations being 136, 132 and 135½ respectively. This stock gained 3 points net. The sales of Metropolitan Street Railway aggregated 23,711 shares, the closing price being 165¾. The net result is a gain of 1¾ points. The highest figure of the week for this stock was 169. Third Avenue continued to be traded in quite extensively, the number of shares sold being 27,028. The quotations fluctuated within wide limits, the highest, lowest and closing prices being 124, 105 and 114½, the result of the week being a net advance of 9½. Western Union closed with a net loss of 1 point. The sales were 1786 shares, the closing quotation being 83. In the market for outside securities last week (four days of trading) there were a number of declines compared with the closing quotations of the previous week, and the transactions were correspondingly small. Most of the electric stocks, including Electric Vehicle and New York Transportation, showed net losses. Electric Boat common closed 2 points lower, and the preferred stock lost 5 points. Electro-Pneumatic continued active, declining with the rest of the market. It closed on Thursday at 3 bid, having sold as low at 2⅜. It lost 1¼ points net for the week. Closing quotations were as follows: Electric Vehicle, 45; do., preferred, 90; Electric Boat, 27; do., preferred, 46; General Carriage, 12; Illinois Electric Vehicle Transportation, 2¼; New York Electric Vehicle Transportation, 12; Telegraph, Telephone and Cable of America, 4½. In Boston the stock market was quiet. Bell Telephone closed at 322, an advance of 11 points over the closing price of the week previous, and General Electric closed at 135⅜. A Boston despatch during the week stated that there is good reason to believe that the General Electric Company is now earning nearly 30 per cent. upon its common stock.

AMERICAN STEEL & WIRE COMPANY.—On April 16 a slump occurred in American Steel and Wire, the common stock dropping from 51 to 42¼ and the preferred from 85 to 80½. Rumor attributes the decline to heavy and aggressive selling by John W. Gates and his associates, and the former is given as authority for the statement that the steel and wire business is in bad shape. This apparently cannot be made to apply to the operations of the Washburn & Moen plant, which has been enlarging its capacity ever since its absorption by the trust, and is employing to-day nearly a thousand more men than two years ago. Twelve Western mills have been shut down, throwing about 10,000 men out of employment. The paralyzation of the building trades by strikes, decrease in demand for barbed wire and falling off in export trade are assigned as reasons.

METROPOLITAN AND THIRD AVENUE.—A special meeting of the stockholders of the Third Avenue Railroad Company will be held on May 11 to vote on the proposition to issue a mortgage on the property and franchise to secure the issue of $50,000,000 bonds. On May 17 the stockholders will again meet to approve the lease of their property to the Metropolitan Street Railway Company. On the same day (May 17) the Metropolitan stockholders will hold a meeting to approve the lease and to vote on the proposition to increase the Metropolitan capital stock from $45,000,000 to $52,000,000 This increase, it is stated, is necessary to complete the electrical equipment of the Broadway and other lines of the system and to provide various other improvements.

ERIE TELEPHONE STATEMENT.—The Erie Telegraph & Telephone Company, incorporated under the laws of New York, and having a place of business in Lowell, has filed with the Massachusetts commissioner of corporations the following certificate of condition of December 31, 1899: Assets—Stocks and bonds, $18,310,000; cash and debts receivable, $1,112,679; total, $19,422,679. Liabilities—Capital stock, $5,000,000; debts, $12,739,403; reserves, $254,144; balance profit and loss, $1,429,131; total, $19,422,679.

NEW ENGLAND TELEPHONE.—The stockholders of the New England Telephone & Telegraph Company will hold their annual meeting in New York, on May 7, and a special meeting to consider the recommendation of the directors that the capital stock of the company be increased from $15,000,000 to $20,000,000. Transfer books will be closed, for both meetings, from April 7 to May 7 inclusive.

THE AMERICAN TELEPHONE & TELEGRAPH COMPANY will make application to the New York Stock Exchange for the listing of its new stock. A Boston despatch, in this connection, states that it has not been determined whether the new stock will receive 7½ or 8 per cent. annual dividend. Bell stock, on April 12, advanced from 317 to 325.

INCREASE OF CAPITAL.—The American Telephone & Telegraph Company, of New York city, has increased its capital stock from $75,000,000 to $100,000,000. The amount of capital stock actually paid in is $70,975,000 and the amount of its debts and liabilities is $24,078,431.

THE INTERNATIONAL STEAM PUMP COMPANY, of New York, has declared a regular quarterly dividend of 1½ per cent. on the preferred stock, payable May 1.

Commercial Intelligence

THE WEEK IN TRADE.—The distributive trade seems to have been affected by the backward spring conditions, which have imparted an appearance of irregularity to the general situation. Evidences accumulate, says Bradstreet's, that active missionary work in favor of lower prices for iron and steel is at last bearing fruit. Pig iron is no lower, but steel products have weakened noticeably during the week. There is practically no change in the copper market, business, it is reported, still being brisk, and prices about the same as those quoted last week. Mr. Jesse Lewisohn is reported as saying that any story that copper mines are uniting their production in order, by keeping down the supply, to keep up the prices, is absurd. "With the present high prices," he said, "there is too much incentive to produce, in order to reap the reward, to keep the mine owners from endeavoring to bring about any such restriction." Prof. W. P. Blake, of the School of Mines at Tucson, Ariz., places the output of Arizona copper mines in 1900 at 150,000,000 pounds. He predicts that within a short time the territory will outrank Michigan and Montana as a copper producing district. The consumption of platinum has increased and prices are higher. Ingot in large quantities is quoted in New York at $18.20 per Troy ounce. Bradstreet's reports the total failures for the week ending April 12 as 152 against 182 the week previous. Regarding the labor situation, Bradstreet's reports that Chicago still remains the storm center of industrial strife, and there is no immediate prospect for a change for the better in that city. The strike has proved acutely baneful to the business interests of the city, and the statement is even ventured that the idleness of upward of 50,000 men for seventy-five days has killed trade for the year. Coal miners' and telegraphers' strikes make up the other disturbing factors.

MARCH EXPORTS.—The March exportations were larger than those of any corresponding month in our history and double the average for the month of March during the decade ending with

1896. The total exports of the month, as shown by the figures just reported by the Treasury Bureau of Statistics, are $134,313,348, against $104,559,689 in March of last year, $75,574,185 in March, 1896, and $66,516,571 in March, 1893. Thus the exportations of March, 1900, are more than double those of March, 1893, and 25 per cent. greater than those of March of last year. The total exports for the nine months ending with March is also greater than that of any corresponding nine months in the history of our exports. The total exportations in the nine months ending with March, 1900, are $1,053,832,675, against $947,919,405 in the corresponding months of last year, $925,905,326 in the corresponding month of 1897, and $515,499,635 in the corresponding months of 1886, having thus doubled in fifteen years and increased over 53 per cent. since 1896.

A BIG ZINC DEAL.—A despatch from Joplin, Mo., brings the information that a ten-million dollar English syndicate on April 11 purchased the South Side Mining & Milling Company's eighty acres of zinc and lead mineral land at Galena, Kan., containing ten mills and fifteen producing mines. The consideration was not given, but is said to be about $500,000. The purchasers will organize a $17,000,000 stock company to operate the South Side mines and will erect a 500-ton mill and sink a 500-foot double compartment shaft and do the deepest mining ever done in the Missouri-Kansas zinc belt. Ore has been found on this property to a depth of 450 feet, and during the nineteen years that this property has been worked it has produced $929,000 worth of lead and $1,100,000 worth of zinc ore. The English syndicate, which is purchasing zinc properties so extensively, is regarded as a gigantic zinc trust, that is planning to control the zinc output of the seven-eighths of the zinc ore mined in America and one-fourth of the world's supply.

MOVING STAIRWAYS FOR THE ELEVATED.—The Manhattan Elevated Railway Company, New York, has asked for an estimate of the cost of 100 inclined elevators to be substituted for the stairways which now lead to the stations along the line of that road. The estimated cost of this improvement is about $250,000. The company, it is stated, regards favorably some form of the inclined continuous-service elevator instead of the vertical elevator. It has been experimenting with the various types and has reached the conclusion that a thoroughly workable apparatus of the inclined type would be much better adapted to the needs of the elevated railways than vertical elevators. The proposed elevators will have a carrying capacity of 3000 passengers each per hour.

HOISTS FOR EXPORT.—The Lidgerwood Manufacturing Company, of New York, has received a contract for the supply of three auxiliary hoisting machines of 75-hp. each, which are intended to serve as part of the equipment for the three 10,000-hp. Bates electrical dredges that are now being built to the order of the Queensland government at Armstrong, Whitworth & Co.'s Walker shipyards, Newcastle-on-Tyne. The value of the contract is said to be $12,500. Among the other recent foreign orders which the Lidgerwood company is at present executing is one for a 30-hp. electrical hoist for mining use in Japan. The order for this was secured through Takata & Co., 10 Wall street, New York.

SAN FRANCISCO DEPARTMENT OF ELECTRICITY.—The San Francisco Fire Commissioners have adopted the annual estimates for the Department of Electricity, which include the following items: Cables for underground district No. 2, $16,450; conduits for the same, $3000; police boxes, $6250; poles, $2000; cement and brick for underground work, $3600; electrical material, etc., $11,660; chemicals, $250; lime, $300. There were also estimates for a new central station building for electrical headquarters, $5000, and entirely new and modern equipment of same, $55,000. Superintendent W. R. Hewitt, at the head of the Department of Electricity, favors the erection of a building with glass sides.

THE ANGLO-AMERICAN RAPID VEHICLE COMPANY was chartered at Dover, Del., on April 11, for the purpose, it is reported, of securing control of the various concerns manufacturning automobiles and unite them in one company. W. W. Gibbs, of Philadelphia, president of the Pennsylvania Vehicle Company, is president of the new concern. The capital stock is $75,000,000, all of which is common, and is divided into 750,000 shares at a par value of $100 each. Among the incorporators are H. B. Twyford, Windley, England; Ernest Martin, New York city, and James Virden, Dover, Del.

ELECTRICALLY-OPERATED COTTON MILL.—A despatch from Springfield, Mass., states that a new mill is being planned for the Chicopee Manufacturing Company, of Chicopee Falls, Mass. It will be 220x120 feet in size, four stories high, and operated by electric power. The proposed improvements also include a new steam plant capable of operating all the mills if necessary, although ordinarily it will only supplement the water power. The steam plant will include boilers of 3000-hp and a 1275-hp engine. These changes, it is reported, will increase the capacity of the looms 33⅓ per cent.

ELECTRIC RAILWAY MATERIAL FOR NOTTINGHAM, ENGLAND.—The United States consul at Nottingham, England, reports that Mr. Arthur Brown, city engineer, will receive American bids for miscellaneous electric railway material for the equipment of the system of tramways owned by the municipality. Contracts for "experimental motors" have already been placed in Sheffield, and the bodies of the cars are being built in England. The wheels will be obtained from Philadelphia and the wire contract is likely to go to New Jersey. American steel rails are reported to be under consideration.

THE AUSTRALIAN TRADE.—It is stated that American electrical apparatus and machinery is receiving extraordinary attention in Australia and that many inquiries regarding the same are being received from that section of the world. An American engineering firm is figuring on a power plant for an Australian town, to cost about $45,000, and an engine-building firm is quoting figures on four engines for electrical work in Melbourne. Besides these there are said to be several inquiries from the same market in the hands of export merchants awaiting orders to purchase.

THE LIGHT & POWER COMPANY, of Colorado Springs, is making arrangements to build a new plant at the coal mines north of the city. Mr. Henry Hine, general manager of the company, is in the East securing machinery and as soon as he returns, which will be about May 1, work on the plant will be commenced. The company has contracted with the Standard Milling & Smelting Company to furnish it with between 500 and 600-hp, beginning January 1 next.

THE TOLEDO BRIDGE COMPANY, Toledo, Ohio, is making plans for the erection of what will be the largest plant in Toledo. The entire plant will be equipped for electric drive. There will be a number of electric cranes, four of 20 tons capacity. The company is considering the possibilities of operating the plant with a gas engine. It is expected that the plant will be completed by January 1. The company is soon to be reincorporated with a larger capital.

WILHELM RENNER, ANGUSTINERPLATZ, COLOGNE, GERMANY, desires to enter into communication with American manufacturers of electrical apparatus and material with a view to handling their products for German speaking countries. Mr. Renner has a wide acquaintance in Continental electrical circles. For exhibits at the Budapest "Thousand Year" Exposition in 1896, he received a jury award, and a gold medal in 1897 from the Brussels Exposition.

THE CORUNA ELECTRIC CO-OPERATIVE SOCIETY, Coruna, Spain, is inviting bids for a complete set of electrical machinery of 400-hp and a 12,000 incandescent lamp equipment. Other electrical machinery and supplies are needed by the same society, which is to make extensive electrical improvements in that district. All necessary information can be procured from the secretary, Senor Enrique Sors, No. 81 Calle Real, Coruna, Spain.

PATROL AND FIRE ALARM IN CLEVELAND.—It has been decided to thoroughly reconstruct the patrol box and the fire alarm systems now in use in Cleveland, O. The patrol system will be extended to all parts of the city and about $60,000 will be expended for this purpose. The new fire alarm service will cost about $55,000. The contracts for these systems will be placed in the near future.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has received an order from the Demerara Electric Company, of Georgetown, B. G., for electrical equipment. The road will be 12 miles long and is being constructed by the company. The Pennsylvania Steel Company received the order for the rails for the new line. Many other contracts, it is reported, are yet to be given out by Mr. W. B. Chapman, of Montreal.

COPPER AND MICA IN THE BLACK HILLS.—According to a despatch from Deadwood it is said that the mining of copper and mica in the Black Hills is of as much importance as the gold and silver workings, and is growing in importance daily. Three hundred tons of mica were shipped from the Hills to Chicago and the East a couple of weeks ago.

THE GRANBY CONSOLIDATED MINING & SMELTING COMPANY recently closed contracts with the Westinghouse Electric & Manufacturing Company's Pacific Coast agency for generators to operate the works located near Grand Forks, British Columbia. The generating units are of 250-kw each.

TELEPHONE CONDUITS IN BOSTON.—The Massachusetts Telephone & Telegraph Company expected to give out on Saturday last the contract for the building of an extensive conduit system practically covering the entire business section of the city. The total length of the duct will be 344,500 feet.

Special Correspondence.

ENGLISH NOTES.

London Office of Electrical World and Engineer, March 31, 1900.

THE CENTRAL LONDON RAILWAY.—It is satisfactory to know that the Central London Railway Company's work is rapidly approaching completion, and practically all that is preventing the new underground railroad from active service is the incomplete condition of the stations. As most of our readers know, this is the latest underground railway that has been built in London, and extends from the Bank, in the very center of the city of London, to Shepherd's Bush, about seven miles due west, the route being directly under Cheapside, Holborn and Oxford Street. The power house, which is situated at Shepherd's Bush, has been completed for some time, and the substations are also ready for work. The tunnels are also complete, and the rails all laid and bonded, and recently very successful experimental runs have been made, an average speed of 30 miles an hour being attained and a speed of 45 miles an hour being developed at points between stations. The stations, which are situated on the average about half a mile apart, have not yet been completed, and the electric elevators have not been installed, so that it looks as if it might be two or possibly three months before the system is really ready for the public. It is believed that the company intends making a uniform fare of two pence for the entire run, something of a novelty for England, as fares for transportation here, either in cars or buses, vary according to the distance traveled. The fare is certainly a low one for the entire run, and is indeed low enough for one-half or even one-third the distance to compete with the existing bus fares. The cars are large and comfortable, and brilliantly lighted, and run smoothly and almost noiselessly.

TRAMWAYS IN BIRMINGHAM.—It is curious to note the backward state the condition of the tramway systems are in such a large and important city as Birmingham. Four different methods are used. In some of the streets a cable is used, on one of the best streets through the residential districts accumulator cars are operated, in a very few streets horse cars are used, but the majority of the street car work is operated by little steam engines. The gauge of the track is only 3 feet 6 inches, which makes the cars extremely narrow and uncomfortable, and even though the cars are pulled by steam engines, which necessarily exhaust disagreeable gases, the cars have top seats and are protected on the top by wooden covers, and have a very strange appearance. These top covers are only about 4 feet 6 inches from the top of the car proper, so that passengers using the top must bend over in a most uncomfortable position when passing from one part of the car to another, to the great destruction of hats, if one is not very careful. Most of the lines in the city are operated by the City of Birmingham Tramways Company, which is at present at a deadlock with the city council. Strong hopes are indulged, however, that arrangements will soon be entered into between the tramways company and the city, by which they will be allowed permission to install the overhead electric system, and so give Birmingham a system of tramways which is up to date. To a stranger visiting Birmingham for the first time it is most astonishing, and without a personal examination is almost incredible. Birmingham is a city of over half a million inhabitants, and how the people can tolerate these obnoxious steam cars in the streets of the city certainly appears strange to one who has visited cities with more modern equipments. On examination, however, it is to be found that the contention between the council and the tramways company, which keeps Birmingham in the background, is that the company has only a lease of the tramways for a maximum of about 11 years. The council will neither give it an extension of the lease nor permission to use the overhead system, which the tramway company is anxious to install. Strong efforts, however, are being made by Mr. Ross, the managing director of the City of Birmingham Tramways Company, to induce the council to allow it to install the overhead electric system, and it is fully believed that within the next few weeks he will succeed in his efforts. Not only are the steam tramways unsightly, but they are also extremely expensive to operate, costing from 8d. to 9d. per car mile, against the overhead electric system of 4d. to 5d. The accumulator system, which is operated on one of the most important residential streets, is more costly to operate.

General News.

THE TELEPHONE.

VALE, ORE.—The towns of Vale and Westfall, Ore., will soon be connected by a telephone line.

TERRE HAUTE, IND.—The Citizens' Telephone Company has increased its capital stock from $25,000 to $150,000.

PHOENIX, ARIZ.—A franchise has been granted to D. C. Hinshaw to establish a telephone exchange in this city.

CHICAGO, ILL.—The Ava & Southern Illinois Telephone Company has increased its capital stock from $2,500 to $5,000.

COLUMBUS, OHIO.—The Jefferson & Warren Telephone Company has increased its capital stock from $40,000 to $60,000.

MEDFORD, WIS.—The common council has granted J. A. Perkins a ten-year franchise for an automatic telephone system.

BALTIMORE, MD.—The Worcester Telephone Company has made a contract for the extension of its lines from Snow Hill to Pocomoke City.

TALLAHASSEE, FLA.—The Apalachicola & Tallahassee Telegraph Company, has been incorporated, with a capital of $10,000, to operate a telegraph and telephone line from Apalachicola, via Carrabelle, to Tallahassee.

BUENOS AYRES, ARGENTINE.—The Co-operative Telephone Company is extending its service to the suburbs and has lately opened an office at Hacdo.

DAYTON, OHIO.—The board of city affairs has closed a contract with the Dayton Electric Light Company to furnish 400 arc lamps at $68.50 per year for a period of ten years.

GRATIS, OHIO.—The Gratis Telephone Company has been incorporated. Capital, $3000. Incorporators: J. S. Steward, J. W. Gregg, G. Hoover, J. Bence, A. M. Fridge.

MINNEAPOLIS, MINN.—The Northwestern Telephone Exchange Company reports a net gain of 742 subscribers in March, making a total number of 18,184 subscribers on March 31.

TILLAMOOK, ORE.—The Oregon Telephone & Telegraph Company's application for a franchise for a local system in Tillamook, Ore., has been favorably acted upon by the city council.

BOSTON, MASS.—The Pacific Coast Telephone System made a net gain of 2170 subscribers in March. The total number connected March 31 was 71,184, of which 18,366 are in San Francisco.

BOSTON, MASS.—The Erie Telephone System made a net gain of 4276 subscribers in March. The total number connected March 31 was 117,603, and the number waiting connection, 6216.

NEW RIVER, VA.—The New River Telephone Company has been chartered Capital, $5000. Incorporators: D. F. Hale, H. Chilton, W. T. Ould, G. C. Shumate, H. H. Hale, all of New Giles.

HAVERHILL, MASS.—The board of aldermen has granted permission to the New England Telephone & Telegraph Company to build conduits through the streets for the burying of the wires.

HERNDON, VA.—The Herndon & Leesburg Telephone & Telegraph Company has been incorporated here by E. L. Roby, B. B. Detinler, J. S. Webster, J. T. Jones, M. M. Fadley and E. L. Detwiler.

PORT ARTHUR, TEX.—The Port Arthur Telephone Company has been incorporated with a capital stock of $5000. The incorporators are S. Goldberg, G. R. Stearns, C. Flanagan, all of Port Arthur.

MUNCIE, IND.—The Delaware County Mutual Telephone Company has been organized in this county to operate a rural telephone system connecting all sections of the county with headquarters at Muncie.

LOST VALLEY, ORE.—The Lost Valley Telephone Company has been incorporated with a capital stock of $8000 for the purpose of building a telephone line. The incorporators are: A. Hardie, C. W. White and J. Trizzed.

MARTINSVILLE, IND.—The Board of County Commissioners have granted a franchise to the Paragon Telephone Company and the Adams & Eminence Telephone Company. More than 300 farmers are interested in these lines.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company has obtained a permit to erect a new brick telephone exchange in the fourteenth ward to cost $6000; also a brick exchange in the twelfth ward to cost $12,000.

ST. PAUL, MINN.—The Farmers' Telephone Exchange Company, Pipestone, Minn., has been organized. Capital, $100,000. Incorporators, T. F. Robinson, O. Cass, W. Frost, Mary M. Robinson, Elizabeth C. Frost, all of Pipestone; O. Cass, attorney, Pipestone.

HOUGHTON, MICH.—The new long distance pole line is now all set between Michigamme and Houghton, where it follows the line of the South Shore road. Between Michigamme and Nestoria the first wire has already been strung beyond the Spurr mine.

NEWPORT NEWS, VA.—The Newport News and Richmond Telephone & Telegraph Company has been chartered. Capital, $25,000. Incorporators: R. P. Orr, W. J Nelms, G. N. Wise, E. G. Booth, C. P. Armistead, N. C. Watts, C. E. McClorer, all of Newport News.

CEDAR RAPIDS, IOWA.—A new farmers' telephone company has been organized for the purpose of constructing a line from Lisbon to Martelle, by way of Springville. The new line will connect with other systems. The Lisbon company will also make extensions.

COLUMBIANA, OHIO.—As a result of the competition of the Columbiana Telephone Company, the Bell Telephone Company has reduced its rates. The Columbiana County Company gives a lower rate and allows patrons the use of connection to any town in the county, free of charge.

INDIANAPOLIS, IND.—The National Telegraph & Telephone Company, of Fort Wayne, has purchased the independent exchanges at Sturgis, Burr Oak and Fawn River, Mich., and Lima, this state. The company now controls nearly 300 exchanges in Ohio, Indiana and Michigan.

PLYMOUTH, MICH.—The Plymouth Telephone Company has just been formed here with a capital stock of $2000 to install an exchange in this place. The officers of the company are: A. A. Taft, president; H. B. Jolliffe, vice-president; E. C. Hough, secretary, and C. A. Fisher, treasurer.

INDIANAPOLIS, IND.—At the annual election of officers of the New Telephone Company these gentlemen were elected directors: S. P. Sherin, A. H. Nordyke, H. B. Gates, A. F. Ramsey, C. J. Daugherty, G. W. Beers and Hugh Daugherty. Mr. Sherin and Mr. Gates will be elected president and secretary, respectively, at a subsequent meeting.

FAIRFAX, VA.—The Northern Virginia Telephone & Telegraph Company, of Fairfax, has been incorporated to operate telephone and telegraph lines, with a capital stock of $10,000. The incorporators are: L. E. Oliver, W. T. Oliver, A. H. Moncure, R. L. C. Moncure, W. P. Moncure, Jr., A. Leigh, E. L. Robey, C. T. M. Wiehle, W. F. Middleton and F. Van Dusen.

PROVIDENCE, R. I.—The Providence Telephone Company has absorbed the East Providence Telephone Company. The negotiations for the merging of the smaller company in the larger have been pending for the last eight months. The East Providence Telephone Company began business about the first of January, 1898, and has conducted it without profit ever since.

PHILADELPHIA, PA.—Mr. Alexander Balfour, who is one of the chief organizers of the Keystone Telephone Company, which is now seeking a franchise in this city, states that within a year the Keystone Company will have expended $2,000,000 in the city, and will be as able to handle the business of Philadelphia as the Bell Company does at the present time.

CHARLESTON, W. VA.—The Burke Telegraph & Cable Company, of New York City, has been incorporated here, for the purpose of operating the Burke system of telegraphy. Capital subscribed, $500, with the privilege of increasing the same to $800,000. The shares are held by Henry Cummins, William A. Weed, Robert Sherwood, Charles G. Franklyn and William Henry Landwall, of New York City.

CHICAGO, ILL.—The Chicago Telephone Company has made an arrangement with the Home Science Bureau of the Chicago Woman's Club, whereby it is now able to supply servants, chaperons, or women to take charge of weddings and social occasions. The telephone company also takes orders for the removal of baggage, and will summon to its subscribers' aid the fire or police department, if necessary.

DENVER, COLO.—Work on the transcontinental telephone line was started last week in the suburbs of Laramie, Wyo. A gang will build the line as far as Fort Steele, going by the way of North Park down the Platte River to Saratoga, and then to the railroad. Other gangs will start work at different points between Laramie and Ogden. It is the intention of the Rocky Mountain Telephone Company to have the entire distance between Denver and Ogden in communication by next fall.

DULUTH, MINN.—There has been a telephone war here for months that seems to have ended in a complete victory for the new anti-Bell company. Since April 1 the Bell system has lost more than 60 per cent. of its subscribers, and has been thrown out of connection with the public offices of both city and county. The anti-Bell concern has been connecting its instruments since March 1, and now has about 1,200 in use, with several hundred more to be connected. It expects to have not less than 2000 telephones in operation by midsummer. The old company, which has been in the city for 20 years, has never had 1000, and now has only a few hundred. The Bell franchise expired by limitation March 1, and the city refused a renewal.

ELECTRIC LIGHT AND POWER.

GRANT'S PASS, ORE., recently voted bonds in the sum of $69,000 for a light and water system.

MINNEAPOLIS, MINN.—The citizens of Parker are agitating the question of securing an electric light plant.

CRYSTAL SPRINGS, MISS.—The city will construct water works and an electric light plant to cost $22,500.

NOBLESVILLE, IND.—The city council has granted the Central Traction Company a franchise to light the city with electricity.

CRIPPLE CREEK, COLO.—The Cripple Creek Consolidated Mining Company has put in new machinery, including an electric hoist.

BEEVILLE, TEX.—A deal has been made with Dunlap & Corby, of San Antonio, Tex., for the establishment of an electric light plant at Beeville.

WALLINGFORD, CONN.—Wallingford Borough is to put $15,000 more into the enlargement of the electric lighting plant, owned and operated by the borough.

OMRO, WIS.—This city may have electric lights. Mr. A. P. Hoyt, of Joplin, Mo., has presented a proposition to the council to light the streets with electric lights.

NATCHITOCHES, LA.—The city will hold an election on April 27 to vote on the question of issuing $30,000 of bonds for construction of water works and electric light plant.

PULASKI CITY, VA.—D. M. Monroe, of Washington, D. C., is preparing plans and specifications, and will have entire charge of erection of electric light plant for Pulaski City.

NEW IBERIA, LA.—The city has voted to issue $112,000 of improvement bonds for erection of electric light plant and construction of water works. Address Weeks & Weeks.

IRONTON, OHIO.—The Ironton Electric Company has been incorporated. Capital, $1000. Incorporators: W. K. Thompson, S. Reinhart, T. J. Bryan, J. Hamilton, T. D. Shirkey.

CHICAGO, ILL.—The Monroe Electric Company has been incorporated, with a capital of $5000, to furnish light, heat and power. Incorporators: Erick Winters, A. Jackson, B. Bounds.

RICHMOND, IND.—The local fight for municipal ownership of the electric lighting plant is now assured, the local company having offered its plant at a reasonable price. A vote will be taken on May 1.

NASHVILLE, TENN.—The Knoxville Power Company has been incorporated. Capital, $10,000. Incorporators: J. T. Wilder, R. W. Austin, T. B. Cormick, J. M. Murphy, S. R. Morrow, all of Knoxville.

WASHINGTON, IND.—The city council has purchased the Graham electric light plant of this city and taken possession. The price was $74,000 and $10,000 additional for the release of the franchise, which had three years to run.

FARGO, N. D.—The Edison-Hughes Electric Company has applied to the council for a forty-year franchise to do electric and gas lighting in that city. The capital of the company will be increased $100,000, and a gas plant added.

RICHMOND, VA.—The Virginia Electrical Railway & Development Company will ask for a franchise, allowing it to extend its lines from Richmond into Manchester, for the purpose of furnishing light, heat and power in the city.

EVERGREEN, ALA.—The city has closed a contract with McDonald & Porter, of McComb City, Miss., for the construction of water works and electric light system here, at a cost of $23,000. The town will issue $25,000 of bonds for the purpose.

CAMDEN, N. J.—The Camden & Burlington Gas & Electric Company has purchased the plants of the Merchantville Light, Heat & Power Company, at Merchantville, N. J., and will have plans drawn at once for extending and making improvements to the same.

ALBANY, N. Y.—A certificate has been filed with the Secretary of State by the Patchogue Electric Light Company, setting forth that its capital stock has been increased from $20,000 to $40,000. The company's directors include Edwin Bailey and George D. Gerard.

DENVER, COLO.—The Lacombe Electric Company, of Denver, has been incorporated, with a capital stock of $1,000,000, for the purpose of erecting an electric plant. The incorporators are: C. F. Lacombe, W. S. Bagot, Z. T. Hill, F. Dorr, M. L. Stern and H. J. O'Brien, all of Denver.

PERU, IND.—The Peru Electric Light & Power Company has asked for an injunction against Ulen & Perrott, of Indianapolis, and the mayor and common council of Peru to prevent them from putting in a light plant for which the common council recently voted a franchise to Ulen & Perrott.

COLUMBUS, OHIO.—In the city elections last week the question of building a municipal electric lighting plant was voted on and passed by a large majority. A resolution has since been introduced into the city council asking that a bond issue to the amount of $300,000 be authorized for the purpose of erecting such a plant.

GEORGETOWN, COLO.—The United Light & Power Company has been organized here to furnish power to mines in the vicinity. Frederick Dewey, of the Bank of Clear Creek, is at the head of the enterprise. It is said that $100,000 will be invested in the plant. The Lamartine mine has signed a contract for power for five years.

PHILADELPHIA, PA.—The Consolidated Electric Company, which was organized recently to take over a large number of electric companies, has just secured the Haverford & Kennett Square Electric Company. The capital stock is now $1,500,000, but, it is said, it will be increased in the near future to $4,800,000. It is stated that the company has other companies under consideration.

MIDDLETOWN, IND.—A woman by the name of Anna D. Welsh has given to Anderson and Indianapolis firms a contract to build her an electric light plant in this city to cost $19,000. She has a 25-year franchise and a 10-year contract with this city to supply it with 30 arc lights at $60 a year for each light. Mrs. Welsh is completing a $25,000 hotel and the electric plant is to be used primarily to light the building.

SAN FRANCISCO, CAL.—The Truckee River General Electric Company has made a good deal of progress on its pole line to the Comstock mines, and the system will probably be ready for operation next July. The company has bridged the Truckee River at the site of the main generating station, the foundations of which are now being constructed. The poles are of heart redwood, 7 by 7 at top, 11 by 11 at base and run from 30 to 40 feet in length.

DENVER, COLO.—One of the aldermen announces his intention to present an ordinance providing for the appointment of inspectors of electric light and gas meters. It is proposed, if the bill is passed, to authorize the inspector to give a consumer a certificate in the event a defective meter is found. Then the city will step in and protect the customer against any attempt on the part of the company to collect for gas or electric light never delivered.

VALLEYFIELD, QUE.—A large force of men is engaged on the work in connection with the new power house for the Montreal Cotton Company at Valleyfield, Que. The hydraulic-electric power to be developed will amount to about 3000-hp. There are about a thousand looms waiting on this power development. The company is very much pressed just now with orders, but expect to have power to operate these thousand extra looms by the first of July next.

LYONS, N. Y.—The Clyde Gas & Electric Company has gone into the hands of Edward Muir, of Marcellus, temporary receiver by order of Justice Davy, upon a petition for involuntary dissolution. The corporation is insolvent. Its capital is $40,000, paid up. It first had a gas plant, then added electricity, furnishing later steam heat and electric power. At great expense an acetylene gas plant was installed. A trolley line to Lake Ontario was projected. Expensive management wrecked the concern.

CRIPPLE CREEK, COLO.—The Cripple Creek city council has granted a franchise to the People's Electric Light & Power Company. The camp now uses sixty arc lights, and under the contract with the People's Company there will be a saving of $3 per lamp per month. The company agrees to pay 2 per cent. of its gross earnings into the city treasury. At the expiration of the ten-year franchise the city is given the option of purchasing the plant at a valuation fixed by an arbitration committee.

MINNEAPOLIS, MINN.—The Minneapolis Iron & Steel Company has been making some additions to its electrical equipment. It now has 2500 feet of 3-foot gauge track connecting the different mills, scrap piles and loading tracks, an electric derrick used in putting scrap iron in the furnaces and supplied with four motors giving a total of 78-hp, one 85-hp electric locomotive of the mining type, having a drawbar pull of 3000 pounds at a speed of eight miles an hour, and numerous small electric motors, altogether amounting to 225-hp. Power is obtained from the street railway company's lines.

DENVER, COLO.—A question has arisen whether the Denver Power & Irrigation Company has lost its franchise rights by failing to pay into the city treasury $2500 on April 1, as required by ordinance. The company has begun the construction of a dam in Platte Canon and proposed to erect a generating station there carrying the current to Denver, where the franchise gave it the right to occupy the street by poles. The company met the opposition of the Colorado & Southern Railroad, which objected to the construction of the dam. The matter was carried to court and decided in favor of the railroads.

SAN FRANCISCO, CAL.—The artificial lights committee of the San Francisco board of supervisors recently voted to recommend an advance of the maximum rate, which the electric companies are allowed to charge for incandescent lighting, from 11 cents to 13 cents per kilowatt. The minimum monthly charge was fixed at $1.50. The San Francisco Gas & Electric Company had

complained that the existing rate was too low for it to make a profit in the suburban districts. It was claimed that it cost that company 9.8 cents per kilowatt to supply the current, exclusive of the expense of maintenance of lines and of reading meters. Engineer A. M. Hunt, of the Independent Electric Light & Power Company, said that with modern apparatus and distributing system the current should be produced for 5 cents per kilowatt.

SAN FRANCISCO, CAL.—The public utilities committee of San Francisco board of public works, at a recent meeting, received estimates from A. M. Hunt, engineer of the Independent Electric Light & Power Company, upon the probable cost of lighting the city by a municipal system. He estimated that a complete distributing system for street lighting, lamps included, would cost $220,000. His company, he stated, would sell electricity to the city at reasonable rates, and he thought the expense for all of the public lighting would not exceed $190,000 per year. That amount is about one-half of the present expense. The estimate given for the yearly operating expenses of a complete municipal generating and electric distributing system was $170,838.

DENVER, COLO.—There is a movement on foot to secure the passage of an ordinance compelling the electric companies to put their wires underground. A bill was once introduced in the council for this purpose, but it died a natural death. It provided that telephone, telegraph, electric light and railway wires should be buried within certain prescribed limits in the business district in five years, and that in the next five years a further outlying district should be cleared of overhead circuits; in the third period the underground system was to be still further extended and all wires were to be buried in the fourth term of five years. It is not likely that the companies will soon be harassed by such legislation, as the overhead wires prove neither a menace nor an inconvenience.

WASHINGTON, D. C.—The following is a list of new buildings projected or in course of construction, which will require electrical equipment. The Virginia Hotel Company is erecting an eleven-story fireproof hotel at the corner of Pennsylvania Avenue and Fourteenth Street, N. W., which will require an electric light and power plant, also electric elevators. Messrs. Davidson and Davidson are erecting an eight-story office building, for which three electric elevators and an electric light and power plant will be necessary. John H. Nolan is building a six-story apartment house, and contemplates installing a light and power plant, and also two electric elevators. A. M. McLachlen will build a seven-story fireproof apartment house, to be provided with one electric elevator.

THE ELECTRIC RAILWAY.

JACKSONVILLE, FLA.—George S. Baxter and others have formed a company to build a street railway in the city.

WASHINGTON, D. C.—The electric railway from Rockville to Washington was opened for regular traffic a few days ago.

CHILLICOTHE, OHIO.—The Chillicothe & Hillsboro Traction Company has been incorporated with a capital stock of $10,000.

GREENSBORO, N. C.—It is reported that Pennsylvania parties have taken up the project to build an electric railway line in Greensboro.

ATLANTA, GA.—The Atlanta Belt Line Railway, now under construction, it is expected will be completed about June 1. It will be six miles in length.

INGERSOLL, ONT.—The council for the town of Ingersoll, Ont., has decided to grant a railway franchise to the Ingersoll Radial Electric Railway Company.

WABASH, IND.—A fifty-year franchise has been granted by this city to the Wabash River Traction Company. The work of construction will begin by July 1.

OTTAWA, ONT.—The railway committee of the Ontario legislature has passed a bill fixing the rate of fare on electric railways in the province at 2 cents per mile.

LOUISVILLE, KY.—The Louisville Railway Company confirms the report that it will change its Bardstown branch to an electric line. D. J. Minary is president of the company.

RICHMOND, IND.—An election to vote on subsidies for the Cincinnati, Richmond & Muncie Electric Railroad has been ordered for May 10 for Webster, Green and Perry townships.

BUFFALO, N. Y.—President Ely, of the International Traction Company, states that this company will expend about $1,000,000 in its preparations to handle the Pan-American Exposition crowds.

ST. LOUIS, MO.—The construction of the Forest Park & Clayton branch of the St. Louis Transit Company's system, from Price post office, the present terminus, to the Clayton road, was actively begun April 11.

HUNTINGTON, IND.—The Oil Belt Traction Company has been incorporated here. Capital, $10,000. Incorporators: Z. T. Dungan, J. A. Jaqua, A. L. Beck, J. A. M. Adair, J. F. France, all of Huntington.

XENIA, OHIO.—D. Bryan, the owner of River Park at Yellow Springs, has offered the Springfield & Xenia Traction Company several thousand dollars and a site for a power house if the line will be extended past his house.

NIAGARA FALLS, ONT.—The town council has granted a franchise to the Sutherland Construction Company, of New York, to convert the old Niagara Falls, Wesley Park & Drummondville horse car line into an electric system.

SAN ANTONIO, TEX.—The San Antonio Traction Company, of San Antonio, has been incorporated. Capital stock $200,000. Incorporators: E. H. Jenkins, A. W. Houston, Reagan Houston, Emerson McMillin and W. F. Douthitt.

NOBLESVILLE, IND.—A franchise has been granted to the Central Traction Company for right of way through this city, and the county commissioners have made a similar grant over the county pikes to various places in this vicinity.

NASHVILLE, TENN.—Among those interested in the People's Railway Company, which was recently chartered, are B. H. Bailey, Charles F. Sharpe and John H. Eakin. The company proposes building about 40 miles of electric line in the city and suburbs.

MANCHESTER, N. H.—The Manchester Street Railway intends to increase its capital stock to the extent of $125,000 in order to provide for the construction of its proposed Goffstown line. The preliminaries for the expansion are already under way.

BRAZIL, IND.—The Brazil Electric Company has contracted with Stone & Webster, of Terre Haute, to furnish the power for the east end of the Terre Haute & Brazil Electric Railway Line. The road from Terre Haute to Harmony—20 miles—will be in operation by June 1.

CHILLICOTHE, O.—The Chillicothe & Hillsboro Traction Company has been organized here by Messrs. W. A. Wallace, Edward L. and G. L. Warson, Dayton; M. McKeehan, Hillsboro, and H. T. Glenn, of Cincinnati, for the purpose of building an electric line between these two cities.

AUGUSTA, MAINE.—The Eastport Street Railway Company has been incorporated. Capital, $100,000. Incorporators: A. D. McFaul, of Machias, W. E. Burton, R. E. Loring, I. S. Penny, W. H. Williams, H. V. Mitchell, W. E. Hingstone, S. E. Lovejoy, all of Boston, Mass.; A. D. McFaul, attorney, Eastport.

BROOKLYN, N. Y.—The annual meeting of the stockholders of the Nassau Electric Railroad was held last week. The following named directors were elected: John E. Boone, Hugh J. Grant, Nicholas F. Brady, Joseph D. Donald, T. S. Williams, A. N. Brady, E. H. Harriman, A. R. Flower and Clinton L. Rossiter.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company expects to have 80 new double truck cars in service by next fall. They will be of the standard interurban type, 44 feet long, double vestibuled and seating 52 passengers. They will be used on local lines in St. Paul and Minneapolis, where the travel warrants it.

NEW HAVEN, CONN.—Trolley rights over half the Shore Route of Connecticut were secured by the recent purchase of the controlling interest of the Winchester Avenue Road in this city by the A. M. Young syndicate. It is said to be one of the first steps toward ownership of the other trolley line from New York to Boston.

HAMILTON, ONT.—The Hamilton, Grimsby & Beamsville Electric Railway extends for 23 miles eastward of Hamilton, Ont., and every mile of its length is through a veritable garden. The line carrried last year 2000 tons of fruit in baskets, and 4500 tons of fruit and other products as freight, being the best return in three years.

READING, PA.—The employees of the United Traction Company have asked for a second increase in wages. Some time ago they were advanced from 12 to 13 cents an hour, and now they request 15 cents an hour, which, they claim, traction companies in other third-class cities are paying. The men say all necessaries of life have advanced.

NEW YORK, N. Y.—The Third Avenue Surface Railway Employees' Benefit Association will be disbanded as a result of the absorption of the Third Avenue Street Railway Company by the Metropolitan. There is a fund of $10,000, which will be distributed among the 800 members. The Third Avenue employees will join the association of the employees of the Metropolitan Company.

CONNELLSVILLE, PA.—The Connellsville & Uniontown Electric Railway Company will erect a power house, to cost $230,000. The road is to be extended from Mt. Pleasant to Fairchance, via Alverton, Scottdale, Pennsville, Connellsville, Dunbar and Uniontown. The plans also include a line from Scottdale to Pittsburg, via West Newton and Monongahela City. The right of way has all been secured.

BRIDGEPORT, CONN.—The Bridgeport Traction Company, which operates 49 miles of track, and is closely identified with the Milford Street Railway, the Shelton Street Railway Company and the Westport and Saugatuck Railway Company, is soon to be absorbed by the Connecticut Lighting & Power Company, which has recently acquired control of several street railways and electric lighting systems in the Naugatuck Valley.

PITTSBURG, PA.—The West End Traction Company won a suit the other day, the facts of which may be interesting to other traction companies. The West End Company had its overhead wires damaged by the wagons of the Moore Machine Company, causing a temporary inconvenience to the operation of its cars. In the hearing the defendant company asserted that the traction company's wire obstructed the roadway, but this the company denied, and a verdict was given in favor of the Traction Company.

PITTSBURG, PA.—The Suburban Rapid Transit Company, which controls all the electric street car lines on the south side of this city, has now completed arrangements to connect its lines with the Consolidated Traction Company by laying tracks across the Twenty-second Street bridge. This will give the inhabitants on the southern bank of the Monongahela facilities for direct communication with the city proper, which they never had before.

DEFIANCE, OHIO.—W. V. Coons, president of the People's Gas & Electric Company, controlling the gas, electric light and street railway plants in this city, has disposed of his interests to W. P. Engle, of Charlotte, Michigan. The deal carries with it the fulfilment of certain promises and agreements made by Mr. Coons, involving the extension of the street railway line, the development of a park scheme and other matters of interest to the residents for the city.

THE AUTOMOBILE.

THE CRESCENT AUTOMOBILE COMPANY, of New York, capital $500,000, has been incorporated in Delaware.

THE NEW ENGLAND ELECTRIC VEHICLE & TRANSPORTATION COMPANY is fitting out a large building in Newport, R. I., with a practice ring, repair shop, etc., also 100 automobiles for general use.

THE HAVANA AUTOMOBILE TRANSFER COMPANY has been incorporated at Passaic, N. J. Capital, $500,000. Incorporators: C. W. Artz, of Rose-

ville; F. H. Ridgway, F. E. Stevens, S. M. Ayers, F. W. Frost, all of New York; C. W. Artz, attorney, New York City.

THE VIRGINIA AUTOMOBILE COMPANY, of Alexandria, Va., has been incorporated, with a capital stock of $100,000, for the purpose of manufacturing automobiles. The incorporators are: C. A. Lieb, J. B. Lackey, G. H. Harris, C. C. Carlin and L. C. Barley, all of Alexandria, Va.

THE NEW YORK ELECTRIC VEHICLE & TRANSPORTATION COMPANY held its annual meeting in Jersey City recently. The three new directors elected were: George H. Day, president of the Electric Storage Battery Company; James Joyce, Jr., William K. Ryan. The other directors were re-elected.

THE BALTIMORE & OHIO AUTOMOBILE SERVICE.—Reference was made in last issue of the proposed electric automobile service in Washington by the Baltimore & Ohio Railroad. The rates for this service will be 50c. for each passenger from the Baltimore & Ohio station to all the hotels and to residences within a given radius. An extra charge of 25c. is made for each trunk taken on the same vehicle with the passenger.

AUTOMOBILE FOR MR. VANDERBILT.—A Chicago despatch states that Mr. William K. Vanderbilt, of New York, has placed an order with the Woods Motor Vehicle Company, of Chicago, for a Victoria electric carriage which will cost about $5000. Instructions were given by Mr. Vanderbilt that no expense be spared in the construction and finishing of the vehicle. It will be ready about May 1, and will be provided with a battery having sufficient storage capacity to propel the vehicle 60 miles.

NEW INDUSTRIAL COMPANIES.

THE ELECTRIC CONSTRUCTION COMPANY was recently chartered at Norfolk, Va., with an authorized capital stock of $40,000.

THE ROWLAND TELEGRAPH COMPANY, capital $500,000, was incorporated at Trenton, N. J., on April 11. The company is to manufacture telegraphic instruments under patents.

THE ILLINOIS SCHOOL OF ELECTRO-THERAPEUTICS AND PATHOLOGY has been incorporated at Chicago. Capital, $20,000. Incorporators: A. B. Slater, C. E. Heckler and G. Shadbolt.

THE LAMP TESTING BUREAU, of New York City, has been incorporated, with a capital stock of $20,000. The directors are: John W. Lieb, Jr., William S. Barstow, of New York City, and C. L. Edgar, of Boston.

THE SLAYTON ELECTRIC CASTER COMPANY, of Tecumseh, Mich., has been incorporated to manufacture Slayton electric casters, insoles, etc. Capital, $20,000. Incorporators: D. L. Whitenack, G. Merritt, C. A. Slayton, Cynthian Slayton, all of Tecumseh.

THE BEVERLY MACHINE & ENGINE COMPANY, Beverly, Mass., has been incorporated, with a capital stock of $200,000, to take over the business of the Beverly Machine Works. The new corporation has secured property in Beverly and will at once erect buildings for machine shops, factories and an electric plant.

THE IRON & STEEL ALUMINUM COVER COMPANY has been formed at Connellsville, Pa., with a capital stock of $500,000. The officers are George Humbert, president; William Wilder, vice-president; W. H. Kirchoft, treasurer; Thomas Walkup, secretary. All but the president, who is a resident of Connellsville, are from Chicago. The company is building a factory and will employ 600 men.

OBITUARY.

JOHN LOVE, inventor of the Love electric railway system, died April 7 at the age of 63. The body was incinerated at Fresh Pond, L. I., April 10.

MR. J. R. STEWART, president of the Bradford Machine Tool Company, Cincinnati, Ohio, died in Riverside, Cal., March 31. Mr. Stewart was a very well known citizen of Cincinnati, popular with every one who knew him, and a member of the Military Order of the Loyal Legion of Ohio, being a veteran of the civil war.

W. J. HOLMES, superintendent of the Erie Railroad telegraph lines and district superintendent of the Western Union Telegraph Company, died at his home in Paterson, N. J., on April 11. He was born in Auriesville, N. Y., in 1838, and during the civil war he was an operator for General McDowell, being stationed at the old home of General Lee in Arlington, opposite Washington. Mr. Holmes was interested in a number of district telegraph companies in different cities throughout New York state.

PERSONAL.

ALBERT A. KURZ and B. RUFUS, two gentlemen prominently connected with the electric railways of Vienna, Austria, were in Pittsburg last week, investigating American electric railroad practice.

MR. F. C. SUTTER, of the Pittsburg Transformer Company, visited New York and Philadelphia during the past week, to attend to considerable new business obtained by the company in these two cities, and to confer with the company's agents.

PROF. REGINALD A. FESSENDEN, who has been instructor of the electrical engineering department of the Western Pennsylvania University, in Pittsburg, has gone to Washington, D. C., to enter upon his new position with the government weather bureau.

PECK—ARNOLD.—Mr. J. S. Peck, a member of the engineering staff of the Westinghouse Electric & Manufacturing Company, and in charge of the engineering work on transformers, was married in Wayland, Mass., on April 11 to Miss Josephine H. Arnold, of Roxbury, Mass.

MR. CHARLES A. MUDGE, chief electrical engineer of the Sprague Electric Company, has resigned his position to accept one with the Allgemeine Elektricitäts Gesellschaft, Berlin, Germany. Mr. Mudge sailed on the steamer Lahn, on April 17. He will visit Paris and Switzerland before assuming his new duties.

MR. WILLIAM DAVID GHARKY will be married to Miss Hannie Fearing Goodall, a daughter of Mr. and Mrs. William Bailey Goodall, on Wednesday, April 25, at Memorial Church of the Advocate, Philadelphia, Pa. Mr. Gharky is a member of the firm of Clement & Gharky, of Philadelphia, the well known electrical engineers and patent attorneys. Mr. and Mrs. Gharky will upon their return from an extended wedding trip, reside at Haddonfield, N. J. THE ELECTRICAL WORLD AND ENGINEER joins with their many friends in wishing the happy couple a bright and prosperous future.

MR. W. J. CLARKE was presented on the evening of April 9 with a purse of gold coin by the students of the New York Y. M. C. A. electrical class, which has been under his charge during the past season, as a token of their esteem and an appreciation of his efforts on their behalf. Mr. M. Hallheimer, attorney and counsellor-at-law, made the presentation address, to which Mr. Clarke fittingly responded. The members of the class were Joseph Hoaghland, Alfred Lucignani, Edw. J. Shannon, William Mackay, Edw. C. Nicholas, M. S. Ahrens, Fred Mitchell and R. C. Weeks.

HONORING MR. SHIPPY.—On the evening of April 12 a complimentary dinner was tendered to Mr. H. L. Shippy by Mr. Ferdinand W. Roebling, at the Waldorf-Astoria, to commemorate the twenty-fifth anniversary of Mr. Shippy's connection with the J. A. Roebling's Sons Company. There were about 20 gentlemen present and a most excellent dinner and enjoyable time were had. Mr. Shippy was presented with a magnificent gold watch and chain and a loving cup in testimony of the high esteem with which he is regarded by his business associates. In one corner of the menu card was an excellent portrait of the guest of honor.

MR. T. W. BEVAN, upon his departure for Brazil to assume the general managership of the Sao Paulo Street Tramway Power & Light Company, was presented by the employees of the Boston Elevated Railway with a solid gold chain and combination Scotish Rite and Odd-Fellow charm, and also an ebony gold-headed cane. He also received a solid diamond-jeweled watch, a gold match box and a gold-headed umbrella from the Ancient and Honorable Artillery Company, of Boston. Other personal friends presented him with a silver brandy flask, which was well supplied, and many other souvenirs. Mr. Bevan for some years was connected with the West End Railway, of Boston, as superintendent of the power plant.

Trade Notes.

AUTOMOBILE ODOMETER.—The Veeder Manufacturing Company, of Hartford, Conn., is soon to place on the market an odometer for automobiles.

HURD & CO.—The address of this new firm of engineers and machinists is 570 West Broadway, New York, not 570 Broadway, as previously announced.

POLE CLIMBERS.—Mr. J. J. Reidy reports a growing demand for the Donnelly climber in the west and south, where they have been introduced but a short time.

THE KENTUCKY ELECTRICAL COMPANY, of Owensboro, Ky., will increase its capital stock to $50,000 for the purpose of manufacturing motors and power machinery.

THE ELECTRICAL EQUIPMENT COMPANY, Boston, Mass., has been dissolved as a copartnership, Mr. W. W. Harding having purchased the interest of Mr. W. C. Woodward.

THE SPECIALTY ELECTRIC COMPANY, 10 Water Street, Brooklyn Borough, New York City, has issued a circular on the "Seco" ground connection and bushing for metal conduits.

THE PITTSBURG COAL COMPANY, operating about 40 of the largest mines in Pennsylvania, is putting in Cross oil filters manufactured by the Burt Manufacturing Company, Akron, Ohio.

MR. O. A. MYGATT, vice-president Holophane Glass Company, 1 Broadway, New York, has gone to Europe. This company has received an order from the Paris Exposition for 600 globes for the machinery and electrical building.

MANAGER W. F. HAYS, of the General Electric Company, Cincinnati, Ohio, reports the sale of a 2000-kw generator to the Cleveland Street Railway Company. Mr. Hays says that the demand for power apparatus is still on the increase.

MR. G. A. BARDEN, formerly superintendent of the works of the Standard Pneumatic Tool Company, Chicago, has been appointed eastern agent for the same concern, with headquarters at 619 Washington Life Building, 141 Broadway, New York.

THE WESTERN ELECTRIC COMPANY, CHICAGO, is sending to the trade price lists on sockets, switches and cut-outs. A large assortment of this material is carried in stock ready for prompt shipment. Price lists will be mailed upon application.

THE FORT WAYNE ELECTRIC WORKS, through its Cincinnati manager, T. J. Ryan, has secured the contract for the new municipal lighting plant to be built in Batavia, Ohio. The plant will require a 75-kw generator and the contract will call for an outlay of about $6000.

MR. J. E. WILSON, for eight years traveling representative of Pettingell, Andrews Company, of Boston, Mass., has recently been engaged by the new electrical supply house, the Stuart-Howland Company, of the same city. Mr. Wilson will represent the Stuart-Howland Company in the eastern states.

THE STANDARD UNDERGROUND CABLE COMPANY, through Charles F. Sloane, Pacific Coast agent, recently closed a contract with the Independent

Electric Light & Power Company, San Francisco, for additional underground cables, valued at $50,000.

GAMEWELL FIRE ALARM TELEGRAPH.—Reno, Nev., has closed a contract with A. J. Coffee, Pacific Coast agent of the Gamewell Fire Alarm Telegraph Company, for a complete non-interfering system. This includes 17 boxes, tower bell and striker and storage battery equipment.

CORRESPONDENCE SCHOOL EXHIBIT.—The Springfield, Mass., *Republican*, refers in complimentary terms to an exhibit of drawings, papers, etc., recently made in the Art Museum of that city by the Scranton Correspondence Schools. Over 600 residents of Springfield are enrolled in the Scranton Schools.

THE ELECTRIC LAUNCH COMPANY, formerly at Morris Heights, New York, has removed to Avenue A and North Street, Bayonne City, N. J. The present building there occupied contains 7500 sq. ft. of floor space, and other buildings in course of erection will increase the floor space by over 20,000 sq. ft.

THE ELECTRIC DEVELOPMENT COMPANY, of Philadelphia, Pa., is about to open up a Canadian office in Hamilton, Ont. Charles Cadmus, promoter of the International Electric & Automobile Company, was appointed resident general manager of the Electric Development Company.

EMERSON BULLETINS.—Bulletin No. 3017, of the Emerson Electric Manufacturing Company, of St. Louis, is devoted to direct connected alternating current exhaust fans, the first of this type put on the market. The motor is of the induction type, of ¼-hp and runs at the low speed of 1000 r. p. m. The fan has eight blades and delivers from 2500 to 3000 cu. ft. of air per minute.

THE MULTIPOLAR DYNAMOS AND MOTORS, type "M. P.," manufactured by the C & C Electric Company, New York, are described and illustrated in Bulletin No. 133, just brought out by that company. Diagrams give elevation and sectional views and dimensions of the machines. The C & C reaction brush-holder is also described and illustrated; also the C & C field regulator and type "A" starting box.

COMMERCIAL DYNAMOS AND MOTORS.—Two circulars just issued by the Commercial Electric Company, Indianapolis, Ind., are devoted to direct connected exhaust fans and electroplating dynamos, respectively. The former are made in sizes from 30 to 48 inches, the respective capacities being 14, 150 and 30,000 cu. ft. of air per minute. The plating dynamos are made in six sizes ranging from 100 to 1000 amperes at 8 volts.

THE STUART-HOWLAND COMPANY, Boston, Mass., opened its store for business on April 2. Both Arthur Howland and Mr. Stuart, the two active members of the company, have been long associated with the supply business, and will spare no effort to serve customers carefully and promptly. The store is light and spacious, and is equipped with every convenience. The firm will carry a full line of high-grade electrical supplies.

DIXON'S SILICA-GRAPHITE PAINT.—In the April number of *Graphite*, published by the Joseph Dixon Crucible Company, Jersey City, N. J., special attention is directed to the subject of a durable and protective paint for smoke-stacks. Two illustrations show stacks painted with Dixon's silica-graphite paint, which is recommended for its qualities of protection and durability. The accompanying testimonial letters refer very favorably to it.

THE ELECTRICAL SUPPLY & MAINTENANCE COMPANY, of Troy, N. Y., which was incorporated recently with a capital of $5000, has elected the following officers: President, Charles H. Smith; secretary, G. V. Phillips; treasurer, Henry Schneider; manager, A. S. Crable. The company has located at 476-480 Eighth Street, and will commence operations at once. Beside dealing in electrical supplies, it will insure electrical apparatus against damage.

GEORGE F. ROHN has removed to 88 Mason Street, Milwaukee, Wis., where fine electrical quarters have been fitted up. The quarters are characterized by the systematic arrangement of the different departments. Mr. Rohn has several fine contracts, among which is the erection and construction work of the large power plant to be installed at the Milwaukee Harvester Works. The machinery for this plant was recently sold by the Westinghouse Electric & Manufacturing Company.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, New York, has just issued bulletin No. 91, descriptive of its interesting line of underground material, comprising the junction service and coupling boxes made under the Tailleur patents, and also the Ferguson safety catches. The export department of the G. I. Company has just issued French, Spanish and German editions of its ten-page folder, summarizing the products of the company. This very neat folder covers a very extensive line of electrical manufactures.

THE AUTO-ELECTRIC AIR PUMP COMPANY, 39 Cortlandt Street, New York City, describes its improved electric air pump in a catalogue recently issued. This pump is stated to be very compact, self-contained, powerful and of low price. It is for the use of physicians, dentists, printers, hotels, etc. This air pump is absolutely automatic in action, requiring no attention more than to oil the working parts occasionally. Wherever a continuous air pressure is necessary or desirable, the automatic air pump is recommended as being indispensable.

POWER HOUSES.—The Berlin Iron Bridge Company, of East Berlin, Conn., is crowded in all departments. It has the contract for furnishing the power plant for the new electric railway company at Wauregan, Conn.; a large power house which the Atlantic Coast Lumber Company is building at Georgetown, S. C.; the City Square Station for the Boston Elevated Railway, at Charlestown, Mass.; a large power house for the American Railway Company at Bridgeton, N. J., and a new power house for the Lexington & Boston Railway Company.

THE GUARANTEE ELECTRIC COMPANY, 133 South Clinton Street, Chicago, reports a flattering outlook for spring light and power installation. Mr. Charles E. Gregory, president of this company, very readily disposed of several fair-sized units since the first of the month, not to mention a large line of smaller machines. This house lately succeeded in obtaining at low prices a very complete stock in standard lines of transformers, switches, starting boxes, etc. The repair department of this firm is the most thoroughly equipped for rapid and exact work, a fact well attested by the volume of business done.

CATALOGUE OF ELECTRICAL SUPPLIES.—The Anchor Electric Company, 71 Federal Street, Boston, Mass., has just brought out an encyclopedia and catalogue of electrical supplies. It is gotten up in neat form, bound in cloth and contains 142 pages. At the left of each page, illustrations of the various devices listed are given, and all the information concerning same is given at the right. This principle is carried out all through the book, so that the customer has illustrations of the devices he may desire to purchase, in addition to dimensions and prices. The book is gotten up in a substantial manner and bears evidence of care having been bestowed in its preparation.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., is sending to the customers of its telephone department a very complete work on telephone troubles, and how to find them. The title of the book is "Telephone Inspector's Hand Book." The book contains many suggestive points on the installation and maintenance of a model telephone exchange or party lines. It also suggests many valuable methods to be adopted in the construction of telephone lines and exchanges, and shows diagrams of telephone circuits. The Western Electrical Supply Company is not sending these books out as a source of revenue, but is supplying them to its telephone patrons with its compliments. Any of its telephone customers who would like a copy should communicate with the company on the subject.

"JAGABI" PORTABLE TESTING SET.—The following testimonials illustrate the appreciation in which this well known testing set is held: Mr. A. H. Yocum, general signal foreman of the Philadelphia & Reading Railway Company, by which railroad a total of more than 15 sets have been purchased from time to time for testing signal apparatus, under date of Feb. 9, 1899, writes: "I am using the 'Jagabi' portable testing sets for resistance and insulation tests on our apparatus on this road, and find them satisfactory in every respect." Again, on March 23, 1900—more than a year later—Mr. Yocum wrote: "I do not see that I can in any way improve on my letter of Feb. 9, 1899, relating to the merits of the 'Jagabi' portable testing set. Same are giving us entire satisfaction." Messrs. Morris E. Leeds & Co. manufacture the "Jagabi" portable testing set, which is for sale by their sole agent, Mr. James G. Biddle, 1038 Drexel Building, Philadelphia.

EDWARD R. KNOWLES has severed his connection with the Sprague Electric Company, with whom he has been connected for the past two years as electric power engineer, and has opened an office in the Electrical Exchange Building, 136 Liberty Street, New York, where he will continue the practice of his profession of consulting electrical engineer and expert. Few men are better known than Mr. Knowles in the electrical and mechanical engineering professions. He is a specialist in the application of electric power and is prepared to electrically equip and standardize all forms of machinery; make expert examinations and reports; draw up plans and specifications; lay out installations, and supervise the same and act as consulting expert in legal cases. Mr. Knowles has had a long and varied experience in designing, manufacturing and installing electrical apparatus, and his all-round reputation and ability is so well known that it is almost superfluous to say much about him.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED APRIL 10, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

646,963. HOUSE TELEPHONE SYSTEM; F. M. Dunn, Baltimore, Md. App. filed Dec. 17, 1898. A simple and cheap apparatus for house uses.

647,006. SPECIAL APPARATUS FOR ELECTRIC BATHS; A. Maggiorani, Rome, Italy. App. filed Dec. 31, 1897. The invention comprises features of construction by which the intensity of the current can be nicely graduated according to the desire of the physician.

647,007-8-9. APPARATUS EMPLOYED IN WIRELESS TELEGRAPHY; G. Marconi, London, England. Apps. filed June 13, 1899; Dec. 26, 1899, and Dec. 26, 1899. (See page 589.)

647,016. PRESSURE REGULATOR FOR COMMUTATOR BRUSHES; J. O. Moissen, Charleston, S. C. App. filed Jan. 25, 1900. A tension scale is provided in connection with the spring which forces the brush against the commutator; the scale shows the degree of pressure.

647,026. HEATING SYSTEM; A. G. Paul, Boston, Mass. App. filed July 6, 1897. A thermostat is placed in contact with a radiator to control a circuit, including an electromagnetic valve, controlling the circulation of water or steam to the radiator.

647,031. ELECTRIC ARC LAMP; J. Rosemeyer, Lingen-on-the-Ens, Germany. App. filed May 31, 1899. The arc is enclosed by two small globes, the gases in the inner globe being forced into the outer globe and thence led in a downward direction to the escape opening. It is claimed that the amount of oxygen which has to be consumed at first is very small on account of this construction.

647,071. ELECTRIC INDICATOR FOR DOORS; R. H. Bordmann, New Britain, Conn. App. filed Oct. 12, 1898. An annunciator indicating when the occupant of a room is in or out.

647,085. SECONDARY BATTERY; H. S. Gladstone, London, England. App. filed Jan. 2, 1900. (See Current News and Notes.)

647,086. WINDING MECHANISM FOR MUSIC SHEET; F. R. Goolman, St. Johnsville, N. Y. App. filed Dec. 15, 1899. Contacts are arranged to automatically throw a winding motor into and out of circuit to automatic-

ally rewind the music sheet upon the delivery spool after the piece has been played and to stop the motor when the sheet has been rewound.

647,097. RAILWAY SIGNALS; J. Jorgenson, San Francisco, Cal. App. filed Aug. 22, 1899. A white light is normally suspended below a concealing casing. When the signal is to to be changed a colored globe is lowered from the casing to surround the light. The globe is moved by electromagnetic apparatus.

647,101. BATTERY CASE FOR ELECTRO-MEDICAL APPARATUS; J. H. Mahler and C. F. Dundadale, Chicago, Ill. App. filed Jan. 2, 1900. A cylinder having end plugs provided with contacts adapted to engage with the ends of a battery cell resting in the cylinder.

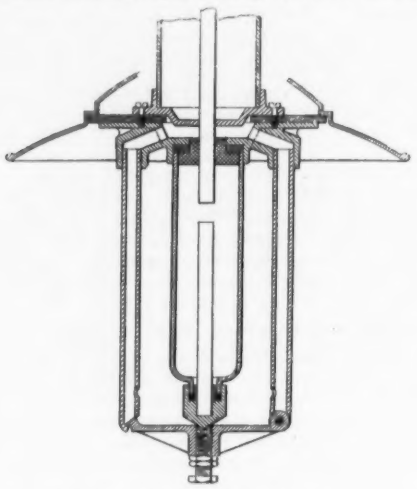
647,155. AUTOMATIC SWITCH FOR ELECTRIC CAR LIGHTING APPARATUS; W. F. Richards, Buffalo, N. Y. App. filed June 5, 1899. Details of construction of a switch operated by the centrifugal force of a rotary shaft.

647,168. SAFETY APPLIANCE FOR ELECTRIC CIRCUITS; E. Thomson, Swampscott, Mass. App. filed Jan. 18, 1899. (See Current News and Notes.)

647,175. TRANSMISSION OF ELECTRICAL IMPULSES; F. Bedell, Ithaca, N. Y. App. filed May 22, 1899. (See Current News and Notes.)

647,177. STORAGE BATTERY TANK; R. M. Chamberlain, Depew, N. Y. App. filed Aug. 19, 1899. The upper edge of the tank is provided with notches into which the lugs of the plates rest and the cover is provided with corresponding notches and also fits over the lugs.

647,193. TROLLEY; J. B. Lynch, G. D. Griffen and J. A. Simpson, Elmira, N. Y. App. filed Sept. 2, 1899. Lateral gripping rollers are applied to the wire in conjunction with the regular trolley wheel, to hold the wheel against



647,631.—Electric Arc Lamp.

the wire, but when it is to be removed the lateral wheels can be displaced by pulling upon a cord.

647,210. ELECTROMAGNETIC ENGINE; P. B. Watson, Philadelphia, Pa. App. filed March 8, 1899. A reciprocating engine in which the actuating force resides in a pair of magnets peculiarly arranged with respect to each other.

647,217. ELECTROLYZING APPARATUS; A. J. O. Chalandre, L. J. B. A. Colas and J. Gerard, Paris, France. App. filed March 21, 1899. (See Current News and Notes.)

647,219. ELECTRIC ARC LAMP; W. J. Cochran, Leroy, N. Y. App. filed Oct. 21, 1899. In this lamp the carbons are arranged at an angle to each other. The invention consists in the details of construction of the feeding mechanism.

647,224. INDICATOR FOR RAILWAYS; R. H. Forde, New York, N. Y. App. filed June 9, 1899. This is a street indicator operated automatically by the meeting of the contacts carried by the roadbed and car, respectively.

647,240. ELECTRICALLY DRIVEN MECHANISM; F. J. Sprague, New York, N. Y. App. filed Sept. 20, 1899. (See Current News and Notes.)

647,250. ELECTRIC METAL WORKING APPARATUS; C. L. Coffin, Detroit, Mich. App. filed April 19, 1899. The machine embodies a number of pairs of clamps arranged at different points on the frame and a movable electric furnace adapted to be moved into heating relation with each clamp.

647,251. STORAGE BATTERY SUSPENSION FOR MOTOR VEHICLES; G. H. Condict, New York, N. Y. App. filed July 30, 1898. A downwardly open space is constructed in the body of the vehicle, between the wheels, and is provided around the sides with supporting devices for a battery tray; all of the supporting devices can be manipulated at once for speedily changing the battery.

647,254. CENTRIFUGAL ELECTRIC SWITCH; E. Cross, Paris, France. App. filed Dec. 6, 1899. The apparatus consists essentially of a kind of governor operating by centrifugal force and the weights of which are each mounted upon a pivoted arm fixed to a rotary shaft and also carrying a metal fork which can apply each of its arms to a fixed ring, the two rings being in connection respectively with the two conductors to be joined.

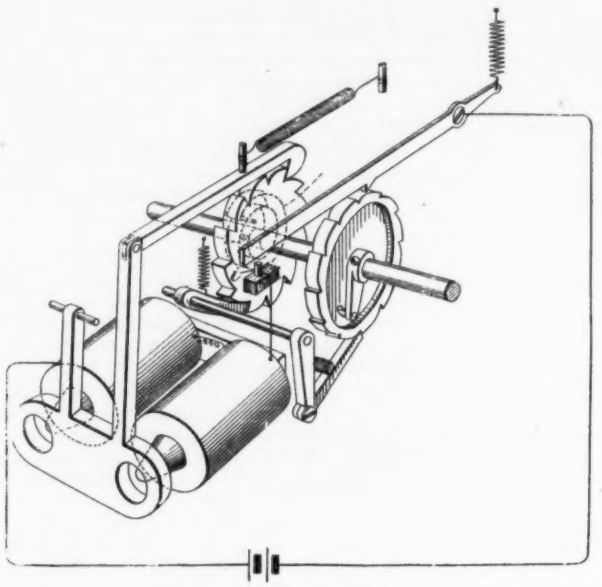
647,291. POLE CHANGER; W. M. Chapman, Needham, Mass. App. filed Aug. 10, 1899. This is a pole changer which permits of a reversal in the direction of travel of an armature shaft, without changing the direction of current in the line circuit; it operates automatically through connections with the shaft.

647,300. TELEPHONE SIGNALING SYSTEM; N. H. Holland, Brookline, Mass. App. filed Oct. 9, 1899. This system includes a signaling device at each station, a generator, a high resistance coil for the signaling device normally in multiple with the line, a low resistance coil for the signaling device normally open-circuited and means for connecting the high and low resistance coil in multiple with each other and in series with the generator.

647,307. COMBINED TELEPHONE EXCHANGE AND FIRE ALARM SYSTEM; J. M. Latimer, Philadelphia, Pa. App. filed July 3, 1899. The object of this invention is to utilize existing telephone circuits for the transmission of fire alarm, burglar alarm or other signals from a subscriber's premises, to fire, police or other alarm-receiving headquarterrs by means of suitable transmitting and repeating apparatus connected to the telephone circuit, but so constructed that they will not interfere with the telephone service or respond to the telephone signaling or talking currents.

647,309. ELECTRIC CLOCK; A. Lungen, New York, N. Y. App. filed Aug. 19, 1899. The object is to provide a mechanism by which the battery power will be economized and for this purpose the mechanism holds the circuit closed just long enough to store a given amount of power in the spring, and no longer.

647,327. TOY; C. J. Rehlin, Allegheny, Pa. App. filed July 22, 1899. The toy consists of a magnetized bar supported above a cannon-shaped device pointing toward it, a figure of magnetic material is forced out of the cannon by blowing into it, and is caught and held suspended by the magnetized bar.



647,309.—Electric Clock.

647,426. SECONDARY BATTERY PLATE AND PROCESS OF MANUFACTURING SAME; P. G. Salom, Philadelphia, Pa. App. filed Nov. 1, 1898. (See Current News and Notes.)

647,414. ELECTRIC SWITCH; W. F. Jones, London, England. App. filed Feb. 6, 1900. This is an electromagnetic circuit breaker, combined with the mechanism of a starting box.

647,434. ELECTRIC ARC LAMP; R. E. Ball, New York, N. Y. App. filed May 22, 1899. Details of construction.

647,442. SECONDARY BATTERY; C. J. Coleman, Chicago, Ill. App. filed Oct. 2, 1899. (See Current News and Notes.)

647,454. ELECTROMAGNET TRACTION APPARATUS FOR STREET CARS; G. M. Moore, New York. App. filed May 24, 1899. The traction is increased by magnetizing the car wheels and axles and the yokes in the roadbed, the vehicle carrying magnets for this purpose.

GERMAN PATENTS, ISSUED MARCH 28, 1900.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

107,976. MICROPHONE; Anton Pollak and Vereinigte Electricitats, Actiengesellschaft, Budapest. App. filed Feb. 14, 1899. The upper carbon in a microphone, which is acted upon in the well-known manner by a contact situated at the centre of the diaphragm, has the form of a horizontal thin strip. This strip is placed among the uppermost layers of granulated carbon in a partially filled chamber, so that only the most sensitive layers of carbon are influenced in speaking.

108,167. STORAGE BATTERY; Franz Heimel, Wien. App. filed May 17, 1898. The active material is covered on both sides with thin sheets of lead. The perforations alternate on both sides and enter quite deep into the active material, thereby securing a large surface of active material exposed to the electrolyte, which material is integral with the sheets of lead which conduct off the current. The gases formed have an easy escape from the active material.

108,176. ALTERNATING GENERATOR; Siemens & Halske, Berlin. App. filed March 24, 1899. Addition to Patent No. 94,564 of Aug. 13, 1896. The arrangement is so modified that two opposite sides of a bridge contain mostly self-induction, and the two other opposite sides contain mostly capacity. There may be employed also a single condenser in the secondary circuit of a transformer having two primary windings, which latter may act in place of the two condensers in the opposite sides of the bridge.